How Programmable Tx's Simplify Setup

MODEL AIRPLANE NEWS

THE WORLD'S PREMIER R/C MODELING MAGAZINE

48120 June 1994

BIPLANE SECRETS!

6 EASY STEPS
OR WING
ETUP

NGINE
DVICE—
oo good
o ignore!

low to Find
he Best Lift

7 Aerodynamic
nsights for
etter Biplane
erformance

Create Great
GAS-ENGINE
SMOKE

SA $3.50 CANADA $4.50

Amazing Scale Story!
Dornier Zeppelin

JUNE 1994 VOLUME 122, NUMBER 6

MODEL AIRPLANE NEWS

ON THE COVER: *Steven Stratt's Dornier Zeppelin is a modeling masterwork built with traditional stick construction (see feature). Photo by Walter Sidas.*

FEATURES

CONSTRUCTION

COLUMNS

DEPARTMENTS

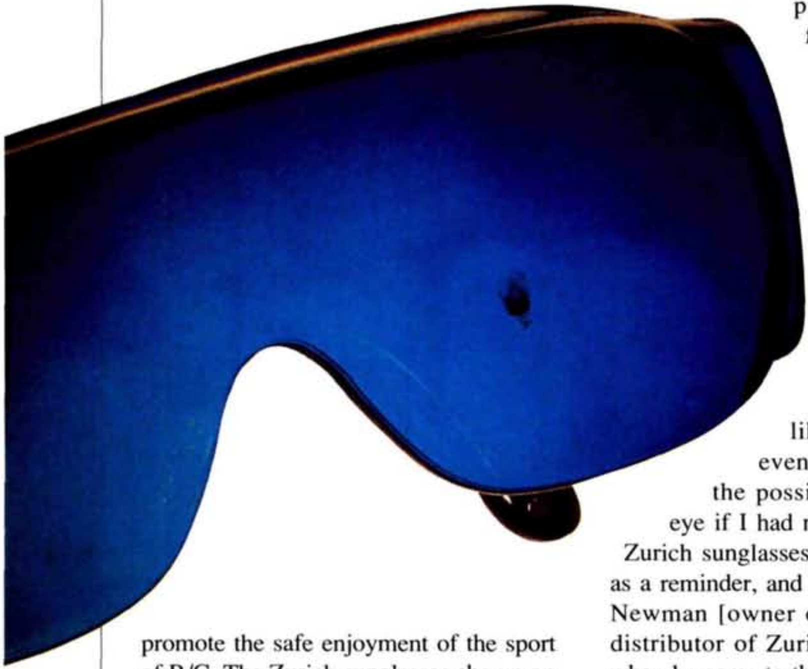
Model Airplane News (ISSN 0026-7295) is published monthly by **Air Age, Inc.**, 251 Danbury Rd., Wilton, CT 06897. Second-class postage paid at Wilton, CT, and at additional mailing offices. Subscription rates are: $27.95 for 1 year (foreign, $40.95); $49.95 for 2 years (foreign $75.95). **Postmaster:** send Form 3579 to **Model Airplane News**, P.O. Box 428, Mount Morris, IL 61054.

EDITORIAL

TOM ATWOOD

SAFETY COMES FIRST

No matter which area of human endeavor you may be involved in, there nearly always is some risk of an accident. Once in a great while, you'll hear about a rare, but serious, freak accident that occurred in the course of R/C modeling. We're all put on notice by such stories to take the greatest care at the flying field to promote the safe enjoyment of the sport of R/C. The Zurich sunglasses shown on this page protected Gene M. Phipps of Puyallup, WA, from injury that could have resulted from such an accident. Take a look at the pock mark in the lens. This is a story worth retelling, and here it is in Gene's own words:



"It's strange to admit this, but I bought my Zurich R/C sunglasses for the wrong reason. I got them because they're the best sunglasses I've ever worn. Let's face it, accidents happen to those reckless guys at the field, not safety-minded people like me, right? *Wrong*. I was recently given a reminder that accidents can happen to anybody. It wasn't even my plane. I was standing about 10 feet to the right and even with the tail of a plane while talking to someone. The plane was held nose high, with the throttle run up to check the mixture.

Several things happened in the space of a few seconds. As I glanced to my left at the plane, something hit my glasses. There was a strange popping sound and a thud to my head as though someone had hit me with a club. The engine stopped running. Out of curiosity I went over and inspected the prop. The prop was fine. I took off my glasses and had a look at them. Almost dead center on the left lens was a dent.

It took a few minutes, but we finally figured out that the glow plug had loosened and exited the engine at bullet-like velocity. I don't even like to think about the possibility of losing my eye if I had not been wearing my Zurich sunglasses. I saved the glasses as a reminder, and so I could show Mr. Newman [owner of Newman Optics, distributor of Zurich R/C sunglasses] when he came to the Puyallup show. He very graciously exchanged the old pair for a new one. I will always wear my Zurichs at the field; I've learned that glow plugs, propellers and such can't tell the safety-minded guys from the reckless ones."

Boyd Newman notes, "It gives me sort of a nice warm feeling to realize the claims of Zurich sunglasses to withstand a 12-gauge shotgun blast from 30 feet not only applies to our hobby, but that one person probably saved his eye because of wearing them—wow!"

I agree with Boyd; this is an impressive story. Readers may have seen Zurich glasses praised before in these pages and in those of other modeling magazines. In addition to being "safety glasses," Zurich sunglasses are among the finest in terms of giving your eyes genuine relief when you're out in the sun for hours on end. This has to do with the clarity of the lens and their ability to filter out UV radiation.

On more than one occasion, when covering major modeling events that last a few days, I've wound up wearing Zurich glasses because my eyes were more comfortable with them than with other glasses (and I always take extra sunglasses). If you want to know more about Zurich glasses, contact Boyd at Newman Optics, 5083 Ridgedale Dr., Ogden, UT 84403; (801) 476-1177.

Do you have any compelling stories relating to safety? Let us know, and we may tell your story in this space. Write to me at 251 Danbury Rd., Wilton, CT 06897; fax: (203) 762-9803; Internet address: toma@airage.com.

UPCOMING EVENTS

If you're looking for a fine family event this summer with spectacular exhibition flights, WW II air-combat reenactments, a mesmerizing demonstration of full-scale aerobatics, AT-6 giant-scale races and opportunities to fly your giant-scale and ducted-fan models (and this is just for starters), then plan to travel to Ankeny, IA (near greater Des Moines), to take in the Aviation Expo '94. It will be held August 3 to 7. Founded by Byron Godbersen of Byron Originals, but now in its second year of independent management, this world-class event is a must-see. The registration deadline for pilots who wish to fly at the event is June 15. For further information, contact Aviation Expo, Inc. at P.O. Box 498, Ankeny, IA 50021; (515) 965-9082.

Also, the '94 Heli-Internationals (IRCHA Jamboree '94) sponsored by *R/C Rotory Modeler* and the R/C Aviation Country Club will be held August 12 to 14 in Columbus, OH. Call Mark Powelson at (614) 924-1242 for information. ■

MODEL AIRPLANE NEWS

Group Publisher	LOUIS V. DeFRANCESCO JR.
Publishers	DR. LOUIS V. DeFRANCESCO YVONNE M. DeFRANCESCO
Associate Publishers	GARY DOLZALL EDWARD P. SCHENK
Editor-in-Chief	TOM ATWOOD
Managing Editor	JULIE SORIANO
Senior Editor	CHRIS CHIANELLI
Associate Editor	GERRY YARRISH
Copy Director	LYNNE SEWELL
Senior Copy Editor	KATHERINE TOLLIVER
Copy Editor	NORA M. MADDEN
Assistant Copy Editor	DEBRA D. SHARP
Managing Art Director	ALAN J. PALERMO
Associate Art Director	BETTY K. NERO
Assistant Art Director	STEPHANIE L. WARZECHA
Art Assistant	ALLYSON NICKOWITZ
Promotional Artist	ROBIN DEMOUGEOT
Staff Photographer	WALTER SIDAS
Image Technician	LISA KNORRA
Director of Information Systems	EDWARD P. SCHENK
Systems Manager	GORDON OPPENHEIMER
Director of Marketing	GARY DOLZALL
Circulation Manager	JEAN BINGHAM ABBOTT
Production Manager	MARY REID McELWEE
Production Assistant	ARLENE MELKO
Advertising Manager	SHARON WARNER
Advertising Account Executives	SHELLEY BYINGTON JILL E. SHERTER
Advertising Traffic Coordinator	ELISE SILKOWSKI
Advertising Sales Coordinator	JILL ELLEN MOLINARO

JBSCRIPTION PRICES: U.S. & Possessions (including APO & FPO): year (12 issues), $27.95; 2 years (24 issues), $49.95. Outside U.S.: year, $40.95; 2 years, $75.95. Payment must be in U.S. funds. Single-ıpy prices: $3.50 (USA); $4.50 (Canada).

) SUBSCRIBE: call 1-800-827-0323.

ODEL AIRPLANE NEWS (ISSN 0026-7295, USPS 533-470) is published onthly by Air Age, Inc., 251 Danbury Rd., Wilton, CT 06897. onnecticut. Editorial and Business Offices, 251 Danbury Rd., Wilton, CT 5897. Phone: 203-834-2900. FAX: 203-762-9803. Y.P. Johnson, esident; G.E. DeFrancesco, Vice President; L.V. DeFrancesco, Secretary; vonne M. DeFrancesco, Treasurer. Second Class Postage Permit paid at ilton, Connecticut, and additional Mailing Offices.

)NTRIBUTIONS: To authors, photographers, and people featured in this agazine, all materials published in *Model Airplane News* become the clusive property of Air Age, Inc., unless prior arrangement is made in riting with the Publisher. The Publisher assumes no responsibility for ısolicited material. Only manuscripts and supporting material accompa-ed by an SASE will be returned.

)VERTISING: Advertising rates available on request. Please send adver-sing materials, insertion orders, etc., to *Model Airplane News*, dvertising Dept., Air Age, Inc., 251 Danbury Rd., Wilton, CT 06897. ıone: (203) 834-2900. FAX: (203) 762-9803.

HANGE OF ADDRESS: To make sure you don't miss any issues, send ur new address to *Model Airplane News*, Subscription Dept., P.O. Box 28, Mount Morris, IL 61054, six weeks before you move. Please include e address label from a recent issue, or print the information exactly as ıown on the label. The Post Office will not forward copies unless you ovide extra postage. Duplicate issues cannot be sent.

)STMASTER: Please send Form 3579 to *Model Airplane News*, P.O. Box 28, Mount Morris, IL 61054

Member Audit Bureau of Circulation

PRINTED IN THE USA

AIRWAVES

WRITE TO US! We welcome your comments and suggestions. Letters should be addressed to "Airwaves," **Model Airplane News,** 251 Danbury Road, Wilton, CT 06897. Letters may be edited for clarity and brevity. We regret that, owing to the tremendous numbers of letters we receive, we cannot respond to every one.

ERRATA

In the February '94 issue, we published the "Madera Unlimited Races" article by Rob Wood but did not list the address of Aviation FX at the end. Here it is: Aviation FX, 611 Monte Vista Dr., Santa Paula, CA 93060.

In the April '94 issue, we published Mike Mayes' article, "Battery Management System One." The RK Electronics charger is manufactured by M&E Electronics, 354 Manchester St., Manchester, NH 03103; (603) 644-3262. The list price is $169.95, not $189.95. For more information, please contact Marc Lapin or Ed Burie.

MOUSSE-CAN MUFFLER FACTS

I'm writing to commend you and the authors of the article, "Make a Mousse-Can Muffler," in the March '94 issue. The instructions and photos are clear and easy to follow.

There is a small problem, however. The purpose of this muffler is to muffle and perhaps to get a little more power from an engine than one could get with the factory muffler. The problem is that the article gave no examples to show how effective the muffler was for either purpose. I presume that it was superior to the factory muffler in some applications, or they wouldn't have gone to the trouble of writing the article.

Do you suppose it might be possible to convince the authors to publish an addendum with data that would inspire the readers to try the design described?

Robert S. Hoff
Bethesda, MD

Absolutely, Robert. We do hope this data inspires experimentation by our readers. The authors, comparing a stock muffler with a mousse-can muffler, measured both sound and performance. Jerry Smith offered the following report. The test was done with a Webra .32 2-stroke with a Dynamax carburetor. They ran a McCoy 9 glow plug and used 20 percent Blue Thunder fuel (distributed by Horizon Hobby Distributors). A Mac exhaust header no. 2340 connected the mousse-can muffler to the .32. The header is 3 inches long along its center line, measured from the flange to the end of the header. Rev-Up props were used. The temperature was 65 degrees Fahrenheit on an overcast day when the test was run. A Radio Shack dB meter was used to test sound levels. The engine was run 18 inches off the ground, and the dB meter was positioned 10 feet from the competition fun-fly airplane and at a 90-degree angle from the fuselage axis, i.e., the meter was placed 10 feet from the engine, following a line extending from the wing root to the tip and beyond.

With an 11x4 prop and stock Webra .32 muffler, the sound level was measured at 95db and the rpm were 12,000. With a mousse-can header setup, the sound was at 97db and rpm were 13,300. Hence, with the mousse-can setup, the sound level was 2dB higher, but the performance gain was 1,300rpm.

The authors also tested a typical competition fun-fly setup, which entails a smaller prop and higher rpm. With a 10x5 prop and the stock Webra muffler, the sound level was 97dB at 14,100rpm. With the same prop and a mousse-can header setup, sound levels rose to 99dB and rpm to 15,100. There was again a 2dB increase in sound, and rpm were increased by 1,000. Jerry Smith notes that the weights of the stock Webra muffler and that of the mousse-can muffler with header were fairly close. With a little care during construction, you can shave some weight off your mousse-can setup for a net weight savings over a stock muffler, even if the savings is slight.

David C. Baron, our "Simple Programming" columnist and avid competition fun-fly competitor (he

took fifth, sixth and seventh place in the last three annual Fun Fly Nats), further notes that these mufflers seem to have better throttle response. He comments that the mousse-can muffler is a kind of tuned pipe—the engine "comes on the pipe," i.e., provides more aggressive throttle response than the stock muffler when you need it in the fast-paced action of fun-fly competition. David also notes that weight savings are a value; the amount of weight saved also depends on the brand of engine you use, as the weights of stock mufflers vary between brands.* TA

GEARED ELECTRIC FLIGHT

Since we publish software that analyzes the performance of electric models (AERO*COMP), we read with interest Mitch Poling's article about gear ratios published in the February '94 issue of *Model Airplane News*. We agree with the equations Mitch published on page 91. We use two other techniques to measure motor characteristics in our program, and then we check our results using the method Mitch describes. It would have been a good idea to write the equations using more parentheses to better clarify the order in which arithmetic operations are to be carried out.

A problem with this method, however, is that a small piece of cardboard or plywood must be mounted on the prop shaft in order to use a modeler's tachometer. This puts a torque on the motor, so this can't truly be called a "no-load" method. Interestingly, the torque shows up as a change in both rpm and current, and the equations still give the correct values for "speed constant" and "armature resistance"!

Mitch assumes that the motor is "lossless." In fact, the losses at low input currents account for a large proportion of the input current. At higher input currents, the losses become relatively less important. It is interesting to note that "loss power" can be as high as 50 watts in large motors at operating (flying) currents.

(Continued on page 104)

IN MEMORIAM

JOHN FLORIO

1931 • 1994

JOHN FLORIO was the modeler we all strive to be. He could design, build and fly aircraft that earned him first-place honors in many categories of AMA competition. His early interests were pattern and pylon racing. After that, he turned to fun-fly competition and was virtually undefeated in the Northeast for more than 10 years. A friend to all who knew him, John was quick to share his insights and knowledge. Fortunately for all of us, his last years were spent kitting his great designs and developing models that were solely for introducing youth to our wonderful sport. John's contributions to the hobby will always be revered as the cornerstones of the sport of model aviation.

We send our most heartfelt condolences to his wife, Nadine, who always attended events with John, and to his son, Jim, who will be carrying on the operation of the Florio Flyer Corporation.

The picture is one that holds special meaning. John rarely boasted of his achievements, but his glow over winning the First Place Overall award in Messina, NY (circa 1987), is just cause for the look of joy on his face. Using a .25-powered trainer, he had beaten all the competitors who were flying traditional 40- and 60-powered planes in the Unlimited fun fly.

David C. Baron

SIMPLE PROGRAMMING

DAVID C. BARON

LINKAGE SETUP AND FLIGHT TRIM

THERE ARE MANY advantages to our modern computer radios, but none is as outstanding as the flexibility they offer when you set up a new model. As long as you've installed your radio in a reasonably efficient manner (servo output arms centered and 90 degrees to pushrods), you can fine-tune your flight controls to a degree of precision that wasn't possible a few years ago. A few words of caution though: a computer radio can't make a bad installation into a good one. Any poorly installed servos, pushrods, hinges and control horns can still ruin the way your plane flies or, worse, cause a crash. I learned many years ago that you should plan your radio installation when you first look at your plans, and that installation should begin just as soon as the fuselage sides are glued in place. Make sure that you have full deflection in both directions on each of your flight controls and that the pushrods don't bind or flex. The bugs should be worked out before you put the sheeting on the top and bottom of your fuselage and wing.

With a computer radio like the Futaba Super 7, you can set up and trim your plane on the bench, or at the field.

ELECTRONIC SETUPS

Let's divide the programmable capabilities of your radio into two groups. The first group is relevant during construction, and the second group is called into play after you've gained some flight experience with your new model. (I'm sure that there *will* be some argument about the second group.) It's true that you will need to estimate some of these functions before you gain any flight experience, but they all will require careful fine-tuning in order to make your models perform well. For the sake of time and space, I will not elaborate this month on some of the basic functions required to wiggle the servos, e.g., Modulation (PCM or PPM), Model Name, Mode Select (aircraft, heli or glider), stopwatch and trainer functions.

GROUP 1—APPLICATIONS DURING CONSTRUCTION

(I've placed these functions in the order that I find most useful.)

• **Reset**. This function can save you a lot of heartburn if you just use it. It's a must if you're using a memory that was used for a previous model. The last thing that you want is to inherit some totally unwanted mix or neutral position for your servos that robs you of performance. Unless you have purposely used the Copy function mentioned below, consider "resetting" the memory to center all the neutral positions and inhibit any unwanted mixes left over from the last plane using that memory!

• **Reversing**. As soon as you have servos connected to pushrods and control surfaces, check your direction of motion. Remember, for a right turn, the right aileron goes up!

• **Wing type (delta, flaperon, or normal) and vee-tail.** The use of these functions may seem self-explanatory, yet I continue to hear from modelers who want to program these functions when they already have these built-in capabilities in their radios. When in doubt, read your manual. These functions usually integrate the channels most commonly mixed, including the blending of the trims. Some offer special reversing capabilities, but I strongly suggest that you check the reversing settings (for the servo plugged into the channel you're about to mix), before you activate one of these built-in functions. It can save a lot of confusion. On some radios, you may end up with your trims working backward, so don't forget to check this critical area.

• **Copy.** This seldom-used function is a great time-saver if you already have a model that's similar to one that you're building. Another ingenious use for this function is to have two setups for the same plane. This is especially valuable for figuring out the proper values for the functions in the second group. During your test flight, you can have two different estimates of the proper throws and values at your disposal.

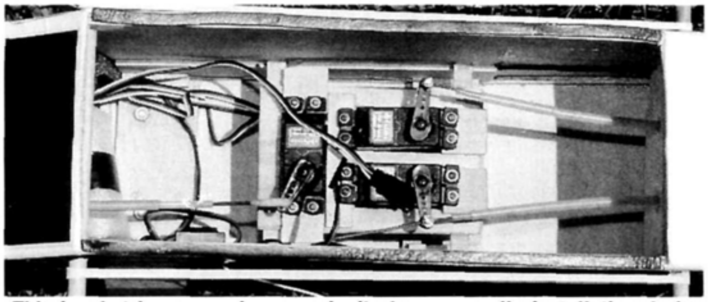
• **Center adj. or sub-trim**. This is another function that's often overlooked and misused. If it's misused, you'll find that you have more throw in one direction than in the other. The first step in its proper use is to mechanically adjust the servo's output arm by rotating it on its splined output shaft so that the arm is as close to perpendicular as possible to its associated pushrod. Once this has been accomplished, use the sub-trim to arrive at a perfect 90-degree angle. It should only require a few degrees of motion.

• **Adjustable travel volumes.** Depending on your experience level, you may look at your new model and have a pretty good idea of how much throw is appropriate for a given control surface. Most kits and plans show recommended values to use as a setup guide. Use these values

unless you're very sure you know what you're doing! The elevator is probably the most critical. When in doubt, less is better (too much is the wildest bucking-bronco ride you'll ever experience). It's at this point that I double-check the center of gravity. As you become more proficient, you can change flight-control volumes.

With throttles, you can set up the necessary throws on the bench. Set the stop points of the carburetor so that the high end gives a full carburetor opening, and the combination of low-end stick throw and low trim closes off the barrel completely. You may need to adjust the idle stop screw on the carburetor if you can't get the desired totally closed "engine kill" position. This feature makes owning a programmable radio a pleasure. We've all been faced with the challenge of setting up a perfect throttle linkage with only mechanical adjustments available to us. It isn't quick or simple to do it that way!

• **Compensation mixes or PMX.** I prefer to program my own mixes rather than use available built-in mixes because I don't like these functions being activated by a switch on the face of the transmitter. (I don't want to accidentally switch off a function that I rely on for the way the model flies.) Another reason is that the switches that activate these built-in commands are too often the type that have three positions. The center is off, and the extremes activate the built-in functions. The problem is that you're forced to choose between the two functions because you can't use them at the same time. For example, on JR's* 347 and 388 as well as Futaba's* 7UAP and 7UAPS, the elevator-to-flap mixing and the landing-mode function (ABRKS on Futaba) are at opposite ends of the same switch, and for a competitive fun-fly model, both should be working full time.



This is what happens when you don't plan your radio installation during the construction phase of your model. For minimum binding and maximum accuracy of control-surface movement, control rods should connect to the servo output arms at right angles. Note the throttle linkage (left); it's the only one set up correctly.

GROUP 2—APPLICATIONS PERTAINING TO MODIFYING FLIGHT CHARACTERISTICS

• **Dual rates.** Many planes on test flights have been saved by smart pilots who have taken the time to use this function. It's always safe to set the high rate for 100 percent and the low rate for 50 to 75 percent. This can prevent a hyper model from over-controlling itself into the ground. You must, however, be prepared to use it. Before the first flight, you must know which switch controls which channel and which direction gives you high and low rates.

• **Exponential.** This function can be like having built-in dual rates. It's used very effectively by most of the experienced modelers at demonstrations and competitions. If you haven't tried it yet, you're doing yourself a disservice. Most of the time, its purpose is to give the stick less sensitivity around center and much more throw at greater stick deflections. Probably, it is used most often on the aileron channel. You can enjoy the soft feel of low rates in the first half of stick motion, and the fun of hot-dog roll rates with full deflection. Futaba allows you to set up exponential in either direction. A negative value of -20 percent is a good place to start. If you accidentally set a positive value, be ready for a wild ride. JR and Airtronics* radios only allow for one direction of exponential value. Again, I would recommend a value of -20 for first-time experimenters.

• **Differential.** I really think you should try this function. It can eliminate the turning or yawing in the wrong direction that's common in aircraft that have high-lift wings or fly routinely at high angles of attack. Have you ever thought that one of your planes needed to have aileron-to-rudder mixing? This is common with models like Piper Cubs. My point is that most full-scale aircraft from Cubs to airliners use built-in differential to simplify coordinated turns. All you need to do to take advantage of this feature is to have a separate servo for each aileron. You'll also have to plug in each servo to the appropriate port on the receiver. Again, fly your plane first to determine whether it needs this function. Start with a value of 15 to 25 percent, and check that there is now less downward throw in the ailerons than upward throw.

• **Flap to elevator, air brakes and crow mixing.** These features require flight first because each of them has the potential to send the plane out of trim in pitch when the function is deployed. All major radio brands allow for re-trimming of the elevator for these functions. Just before takeoff, I open the programming section of the radio to the function I am setting up. I then make minor changes after each landing until I have a trimmed plane. Give yourself plenty of extra altitude before actuating each function.

**Here are the addresses of the companies mentioned in this article:*
JR Remote Control; *distributed by Horizon Hobby Distributors, 4105 Fieldstone Rd., Champaign, IL 61821.*
Futaba Corp. of America, *4 Studebaker, Irvine, CA 92718.*
Airtronics Inc., *11 Autry, Irvine, CA 92718.* ■

AIR SCOOP

CHRIS CHIANELLI

New products or people behind the scenes; my sources have been put on alert to get the scoop! In this column, you'll find new things that will, at times, cause consternation, and telepathic insults will probably be launched in my general direction! But who cares? It's you, the reader, who matters most! I spy for those who fly!

R/C UFO?

It's not the government's first effort at anti-gravity propulsion, but Sikorsky's new Cypher is one of the most advanced R/C aircraft. Two counter-rotating (coaxial) four-blade propellers driven by a 52hp, 2-stroke, rotary Alvis engine propel this doughnut-shaped, 300-pound, 6.5-foot-diameter, unmanned aerial vehicle (UAV) exactly where its pilot wants it to go. Since its first flight in '92, it has clocked 75 R/C hours, all within visual range of its operator. Cypher has a service ceiling of 8,000 feet and an operational radius of 30 kilometers, and it's designed to carry surveillance and security equipment, e.g., ground-penetrating radar to detect land mines, in battle areas. It is also envisioned to work in hazardous areas (including the interiors of smokestacks!) and to help with search-and-rescue operations. Cypher is designed for stability, not aerobatics.

We called Sikorsky's Bryan Cotton, the Cypher test pilot (who was trained to fly R/C helicopters early in the project by *Model Airplane News* columnist David C. Baron) to see how it differs from flying a model helicopter. Bryan is a software engineer at Sikorsky, and he helped to write the code that is part of Cypher's guidance system. Although the transmitter looks familiar (gymbals are set up like a normal R/C transmitter), Cypher has a big advantage: on board is a Honeywell computer tied to solid-state rate and attitude gyros.

Unlike an R/C heli, Cypher is self-stabilizing: if you let go of the joystick, the aircraft will automatically go back to a level attitude. The right joystick moves the aircraft left and right and forward and backward, and the left stick provides yaw control. But that's only the beginning. It doesn't matter which way the aircraft is pointed; tell it to move right or left from your point of view, and the onboard computer will move the aircraft accordingly. Cypher considers its nose to be pointed away from the transmitter at all times. Bryan was inspired to program in this feature after struggling with nose-in hover with an R/C heli. For over-the-horizon flight, the camera, through which the remote pilot flies the craft, becomes the nose. Ultimately Cypher will be nearly autonomous; the pilot will tell it where to go and, using signals from GPS satellites, it will find its way to its destination on its own.

Do you have to have one? We'll let you know when they are coming off the production line.

New in America

The name Jamara (pronounced ya-ma´-ra) may not mean anything to you, but they have been distributing model products in Europe for many years now. The Fokker D7 and the ⅕-scale Vagabund are two all-wood biplane kits that are available in the States. The D7 has a 61-inch wingspan; it calls for a .60 to .90 4-stroke engine; and it tips the scales at 7.5 to 8.5 pounds. The ⅕-scale, 63-inch-wingspan Vagabund weighs in at approximately 8 pounds. It's designed for electric power and uses a 2.5:1 reduction motor-drive and 14 cells, e.g., Jamara's Tech Motor 350 S/12. The builder may also opt for .40 2-stroke or .60 4-stroke power. For more information on these and other Jamara products, write to Alpha USA, 55 Leveroni Ct., Novato, CA 94949; (800) 685-8290 or (415) 884-3030.

'94 WRAM SHOW

Two Stars

Our star advertising sales manager Sharon Warner holds Sig's new Tri-Star canard. The Star has a 48-inch span and can be built for glow power or electric power, or as a slope glider.

A standard 4-channel radio is all that's needed; no channel mixing required. It's constructed of laser-cut balsa and plywood and has partially sheeted foam wing-cores. Power requirements: .09 to .15 glow, .05 electric (or cobalt); seven cells (1000 to 1700mAh). Available this spring.

The Big "GQ"

This new Soundmaster in-cowl Pitts-style muffler (model no. SMQ-GAS) is designed for 2.2 to 4.2ci gas engines. The muffler can be mounted as shown, or a flex header can be added for remote mounting when a direct connection isn't possible. The pressure tap may be used for smoke feed. Preheating is unnecessary owing to Soundmaster's all-steel construction and internal baffle system. The Big "GQ" (Gas Quiet) has been measured at well below 90dB at 9 feet with little or no power loss. Contact Davis Model Products, P.O. Box 141, Milford, CT 06460; (203) 877-1670.

Show Girls

The Zapettes

OK, there's no *politically* correct way to talk about these two, so why try. We've all seen these two leather-clad beauties before, haven't we, boys? I'm sure you were all mesmerized by that recent Pacer ad in which the girls posed. I think, possibly, Pacer would do quite well in the pantyhose business, too! They are none other than Carol Tiano (left), wife of that nefariously lovable Frankie Tiano, and her sister Judy DeYoung. But wait! With a maiden name like DeYoung, and considering both are exceedingly youthful, maybe "The Zaplings" is a better name for the magnetic show team.

Giant Jet Power

Josh Harel Models (JMH) offers this Prop-Fan shrouded-prop fan unit, which is suited to large models weighing up to 22 pounds. Using a K&B .82, this unit drives JHM's 64-inch-span Spartan sport jet at speeds of up to 100mph. (I'll cover the Spartan in a future "Scoop.") JHM claims 18 pounds of thrust at 18,000rpm. The Prop-Fan features straightforward installation and is available pre-drilled for K&B .82, BVM .80, O.S. .77, O.S. .91, OPS .80, Rossi .81 and .90 engines. A lifetime warranty is offered to original owners. I almost forgot! The Prop-Fan is now available with onboard electric starting (shown). For more information, contact Josh Harel Models, 286 Hawthorne Ave., Derby, CT 06418; (203) 732-0532.

The Line Continues

Byron Originals has had such a favorable response to their ⅕-scale Sukhoi that they've added this Extra 300S. Construction is typically Byronesque in that the fuselage, cowl and wheel pants are fiberglass, and the wing and stab are wire-cut foam. Specifications: wingspan—64 inches; length—55 inches; weight—11 pounds; power requirements—.60 to .90 2-stroke or 1.20 4-stroke engine. I'd love to see even more ⅕-scale offerings from Byron. They're perfect for the job! How about a 72-inch Super Chipmunk?

Stinger at 40

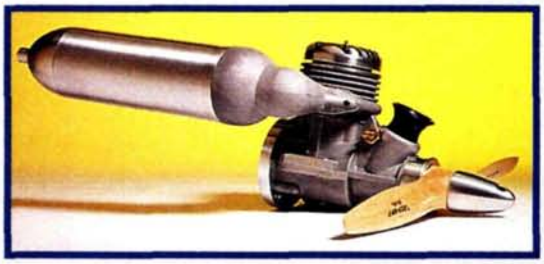
Now there's a Lanier Stinger for .40-size-model lovers. Like the rest of the Stinger series, the Stinger .40 features the proven and highly successful BFPP (balsa, foam, ply and plastic) system developed by Lanier's engineers. The 4¾- to 5¼-pound Stinger has a 48-inch, fully symmetrical wing with an area of 528 square inches, and it requires a .32 to .46 2-stroke engine. The kit includes all the necessary balsa and plywood parts, cut-foam wingcores, formed 6061-T6 aluminum landing gear, plans, instructions and a vacuum-formed turtle deck, wing cover, cowl, canopy and wheel pants. Like all Stinger kits, hardware is *not* included. That's just fine with me. I'm very particular about the hardware I use, and half the kit-included stuff ends up in my "future-use" (in reality, never-to-be-used) box. Contact Lanier RC, P.O. Box 458, Oakwood, GA 30566; (404) 532-6401; fax (404) 532-2163.

Valiant Tracker

AristoCraft (a manufacturer of radios for more than 40 years) has taken its 50-channel synthesizing Valiant 8 system and vastly enhanced it to include every imaginable function. Features include selectable PPM or PCM; smooth and fast servo response; five-model memory; three-way flaperons; a three-way vee-tail; permanent memory settings and much more. According to Polk's Hobbies (AristoCraft's distributor), the Valiant Tracker is FCC-approved, and a patent is pending for frequency scanning and synthesizing. Moreover, it's impossible to transmit to a frequency in use, even if the signal is coming from a field several miles away. In short, the Valiant Tracker prevents you from flying on a frequency where any type of interference exists. Coming this summer. For more info call: (201) 332-8100.

Formula I—More Fun?

Many of the big names in scale have been jumping on the Formula 1 bandwagon, and Dave Bridi is one of them. There certainly are many great-looking, full-scale racers out there just waiting to be modeled. Anyway, here's Dave with his new 42-percent Shoestring kit. Its features include a 14-percent root chord, an epoxy/glass fuselage, wheel pants and wingtips, foam wing and stab cores, Dural landing gear and a canopy that meets Madera specs. Contact Dave Bridi at Horndog Aircraft: (310) 212-3257; fax (310) 320-8354.



From Edmunds Engineering

Edmunds Engineering, which supplies hardware to the aerospace, motorcycle-racing and outboard-hydroplane industries, is introducing the Edmunds Quickie 500 racing engine. Features include a case that's investment-cast from 356 alloy and heat-treated to T-6 temper, an ABC piston/sleeve, a button-style cylinder head, a radial-mount backplate, an upper and lower 2024 alloy bushed conrod and a tuned muffler. A sport model with an R/C carburetor will be available this summer. For more information, contact Edmunds Engineering, 4592 Beech Rd., Temple Hills, MD 20748; (301) 423-1825.

Smart Throttle

There are a lot of speed controllers out there, but Ace R/C's new Smart Throttle distinguishes itself with a great safety feature: it always thinks the throttle is at the low end when the power comes on. This means that if you accidentally complete the circuit that would start the motor—and the throttle is full on—nothing will happen. Pull the plug on the batteries, then pull the throttle back to the "off" position and reconnect; the motor will now respond as you increase throttle. It's all computer-moderated, so there's no need to adjust a gain or neutral control. The compact, 2.1x1.6x.5-inch throttle weighs 52 grams, will take up to 26 cells and 35 amps and costs a reasonable $59.95. See your local hobby dealer, or call Ace at (816) 584-7121 for more information.

PILOT PROJECTS

A LOOK AT WHAT OUR READERS ARE DOING

GERMAN PHANTOM

Arno Knell of Mainz, Germany, built this impressive F-4 Phantom jet fighter from an ITP kit, and he powers the model with two Rossi .90 engines coupled with two Byron fan units. Arno is a former navigator with the German Luftwaffe, and his model duplicates the markings of the aircraft he actually flew during his military service.

BIG BEAUTIFUL BOEING

Phil Yovino of Port Washington, NY, built this 90-inch-span Boeing F4B-2 bipe from Bob Morse drawings. Powered by a Quadra 52, the model is covered with Supershrink Coverite and painted with Krylon paint. A Futaba PCM radio controls the beautiful, 21-pound model. The photo credit goes to Philip's good friend Cris Marici.

BIGGER BIG BOMBER

Nick Rivaldo of Long Beach, CA, likes big twins; when he decided to build a Nick Ziroli B-25 Mitchell Bomber, he thought that the 101-inch span wasn't big enough! He called Nick Ziroli, who agreed to enlarge the plans. Mr. Ziroli also made the cowls and all the formed windows for the project. The new plans turned out a 122-inch-span, 94-inch long model! It weighs 52 pounds and is powered by two Zenoah G-38 gas engines turning custom Zinger 18x8, three-blade props. An Airtronics Vision radio controls all the surfaces, including working flaps and functional bomb-bay doors. Heavy-duty servos are used throughout, along with a 2,000mAh battery pack and 22-gauge servo-wire leads.

FLOATIN' AROUND

Paul Martin Jr., of Oxford, MD, built this unusual EDO OSE-1 Navy floatplane from Ed Westwood plans. The approximately ⅙-scale model has a 72-inch wingspan and is finished in Rustoleum paint. Powered by a Saito 120 4-stroke engine, the model features an operational bomb drop and flaps. Paul says that it's one fine seaplane and that he's looking forward to building a larger, ⅕-scale version with a 91-inch wingspan.

SEND IN YOUR SNAPSHOTS

Model Airplane News is your magazine and, as always, we encourage reader participation. In "Pilot Projects," we feature pictures from you—our readers. Both color slides and color prints are acceptable.

All photos used in this section will be eligible for a grand prize of $500, to be awarded at the end of 1994. The winner will be chosen from all entries published, so get a photo or two, plus a brief description, and send them in!

Send those pictures to: Pilot Projects, Model Airplane News, 251 Danbury Rd., Wilton, CT 06897.

Mobile and ready

by FAYE STILLEY

Build an AIRCRAFT CARRIER

The result of my quest for the ideal R/C aircraft carrier is something like a sedan delivery. The driver can see out all the way around through the tinted glass, but it's almost impossible to see in.

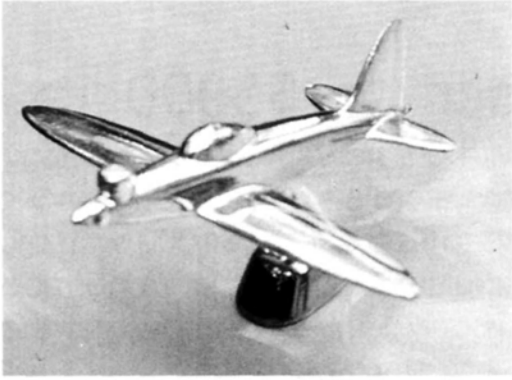
The car was made by Imperial Coachworks in Pittsburgh, PA, for a surprisingly affordable price. They can also convert your late-model wagon into an aircraft carrier if you wish. When the car was delivered, I was thrilled with the workmanship and immediately began to turn it into a real R/C aircraft carrier and field-support vehicle.*

The interior is much larger than you might think. With the seats folded down, a flat floor is created; it measures 49x89 inches from the tailgate to the back of the front seat. The ceiling is 29½ inches above the floor. At the window level, its width is 70 inches, the distance from the tailgate to the dashboard is 128 inches; to the windshield, it's 145½ inches. A 10- to 12-foot, one-piece wing can be carried by putting it between the seats or resting it on top of the passenger seat. There's plenty of room here for most airplanes and more than enough for several sport-size birds.

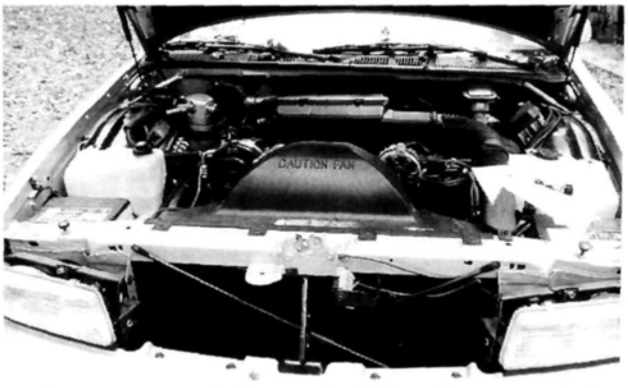
Editor's note: our readers aren't all going to rush out and order a new "aircraft carrier." Faye Stilley, however, has made several clever modifications to his automobile that should be of interest to everyone who would like to fit up their own vehicle for better field support.

THE SEARCH for an "aircraft carrier" began when I became frustrated with my pickup, which had a cap over the cargo bay. Things toward the front were impossible to get at without crawling inside. And I was always concerned about leaving the truck parked because the contents could be seen easily. A fiberglass cap would be no contest—even for an amateur thief.

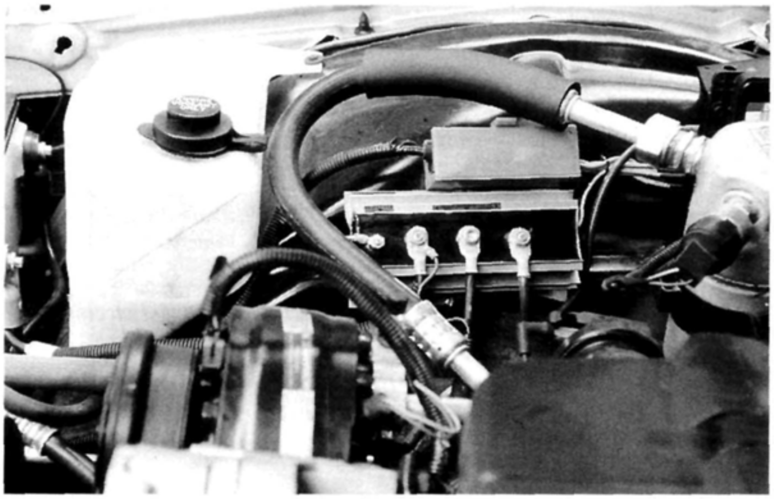
I didn't want a four-wheel-drive monster or a minivan that looked as if it should be full of kids. Station wagons turned me off because with all the glass, everything inside was clearly visible. The ideal auto would be a sedan delivery vehicle, like the ones they made back in the '50s. No such thing is available in the '90s, so I decided to have one made on a large station-wagon chassis The pictures tell the story.



Note the hood ornament—R/C of course!

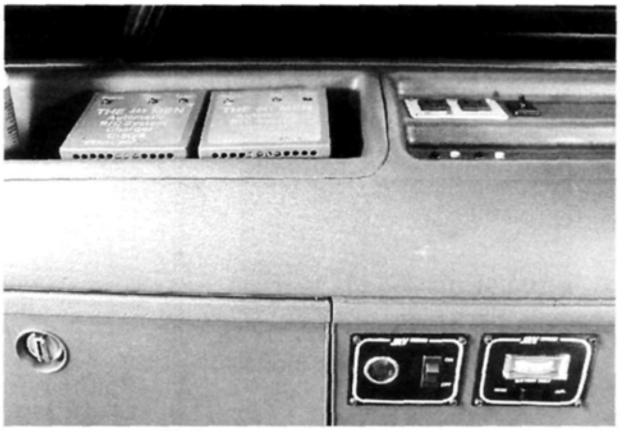


I added an auxiliary battery so that I'd be able to leave battery packs on charge without worrying about draining the regular battery. It fit neatly in the space originally occupied by the emissions canister, which was moved to a new location (see arrow). The regular car battery is on the left.



I installed a battery isolator so that the alternator would be able to keep both batteries charged. The isolator allows the alternator to be connected to both batteries, but it prevents either battery from draining the other. It's a simple diode device. The amperage rating must match or exceed the output of your generator or alternator. I also installed a switch between the isolator and the auxiliary battery. This allows me to have the alternator disconnected while driving with battery packs on charge. The power inverter is stable at 120 volts AC, even with the alternator running. The 12V DC chargers, however, are affected by the input voltage increase from the alternator.

"I added an auxiliary battery so that I'd be able to leave battery packs on charge without worrying about draining the regular battery."

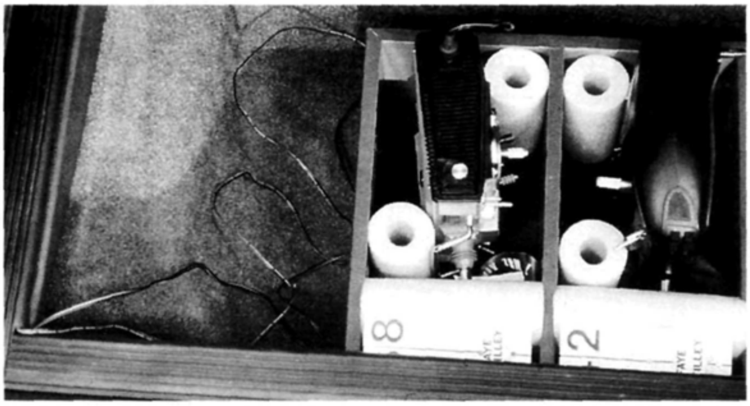


I wanted to be able to drive directly to the field from work. That meant that I needed some way to keep the flight packs and transmitters on charge while the car was parked. I installed a power inverter that provides two 120V AC outlets for regular chargers. I use two Model Engineering of Norwalk chargers because they're pulse chargers and can be left connected indefinitely without overcharging the battery packs. They're installed in the rear of the car near the tailgate. The picture shows the power inverter and its switch (upper right) and the chargers (left). The black-and-white jacks near the inverter are for the receiver packs. The transmitter charge jacks are near the transmitter storage area; I'll discuss this later.*

I installed a 12V DC output with a typical cigar-lighter jack below the 120V AC output. I use this for my 12V DC chargers. The meter alongside the jack monitors the auxiliary battery. All these items, except the M.E.N. chargers, can be found at R/V and marine supply stores.

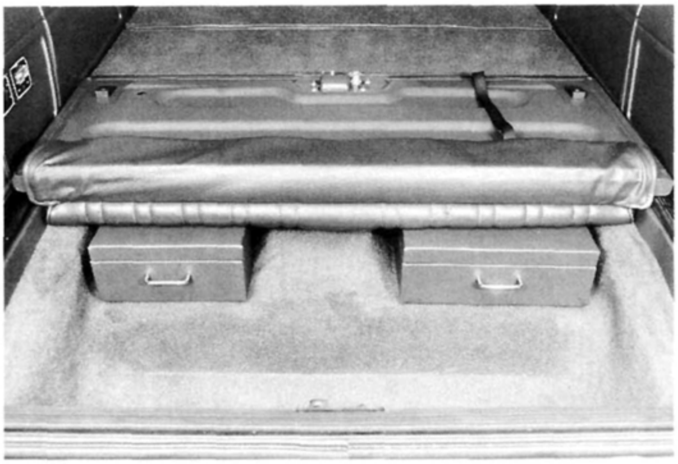
A compartment at the rear was converted into a fuel compartment. It holds three 1-gallon jugs. It has a sealed bottom pan, so if the fuel spills, it will stay within the compartment. When I carry less than 3 gallons of fuel, I use empty fuel jugs to fill the extra space and prevent things from moving around. A small Halon fire extinguisher is above the fuel compartment. I've never had to use it, but you know the old saying.

I built a tray that fits in the well behind the storage area for the boxes. The tray is padded and will accommodate up to three transmitters. I keep my pit box and other things in the tray when I'm not carrying three transmitters. The tray has slots in the sides that serve as handles for easy removal.



This picture shows two transmitters plugged in and charging. The transmitter charging jacks can be seen on the left. The transmitters rest on their sides because some have the charge jack on the back, and others have the jack on the side. The doughnut-looking things are slices of pipe insulation; I wedge them against the transmitters to hold them securely in place while traveling. The rear floor section, which can be locked, covers this area and keeps everything secure.

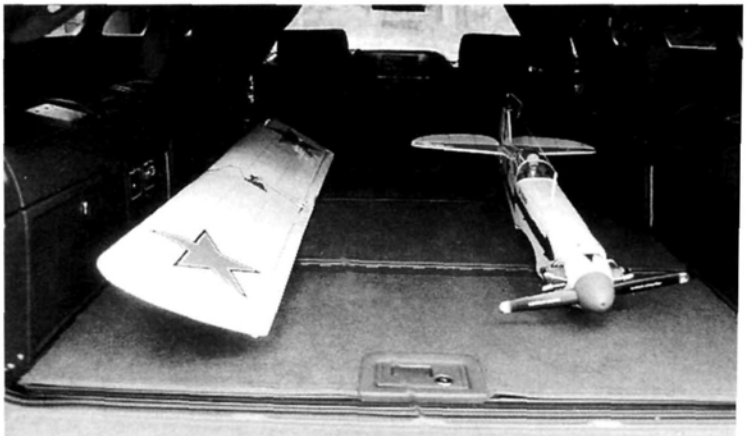
BUILD AN AIRCRAFT CARRIER



Lifting the rear section of the floor exposes a well and tool and accessory boxes. I built them to fit under the rear seat where the seat cushion used to be. They're slightly wedged in by the padding on the seat back and travel securely without moving.

With the boxes open, you can see that I've tried to make a place for all those things that you never seem to have when you need them. In the box with the small dividers, I have small jars for extra small parts: wheel collars, screws, clevises, gear straps, small horns, etc. The dividers are egg-crate style so they can be removed to make storage areas of various shapes. The shelf with all the tools fits on top of the divided section. The other box is for long things, such as props and air pumps. It also holds wheels, spinners and glue. It will hold props up to 20 inches in diameter, spinners and wheels that are up to 4½ inches in diameter.

What do you do when the guys find out that you have all this stuff in your car? Don't take money for anything, or you'll become the convenient field hobby shop, and you'll find yourself running to the local hobby shop to replenish your equipment. I "lend" things to people and write everything down in a book. I ask that whatever was borrowed be returned—same for same—even if it's just a screw. What do you tell the guy who doesn't return whatever he borrowed when he asks again? You just look in the book for the answer.



All loaded up and ready to go, the car's interior dwarfs the 60-size Super Sportster. This was a fun project—a nice break from balsa dust. What a pleasure it is to know, when you do get a chance to go to the field, that everything is ready and that you won't leave anything behind!

*Addresses are listed alphabetically in the Index of Manufacturers (for page number, see table of contents).

MODEL AIRPLANE NEWS MAGAZINE CONSTRUCTION

Big Pappy

PHOTOS BY A.T. LANCE *(T.A.G. St*

Easy does it

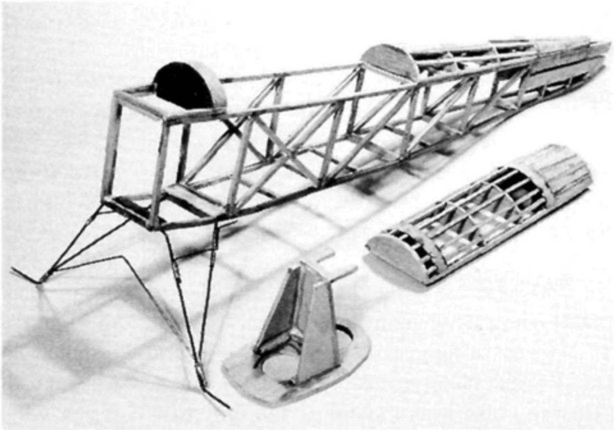
by CHARLES D. EVAN

The author with his granddaughter and Big Pappy—complete and bare bones. Granddaughter learns to build by working on a Goldberg Electra (8 years old going on 30).

MANY YEARS AGO, as a young boy, I was befriended by a gracious man named Harry Moyer, who was one in a million—never too busy to answer the questions of an inquisitive young mind. His Moyer Model Shop in Lebanon, PA, was open until he was too ill to tend to business. He never refused any young person who didn't quite have the money to buy a kit, a tube of glue, a stick of wood, or anything he needed. When confronted with "Gee, I don't have enough money," Harry would look at some fictitious pric sheet and say "That has the wrong pric on it. You have just the right amount. The youngster would then go happily o his way. Harry must have lost his shi more than once.

The attributes of great men like Harr Moyer often go unsung for years, but th Lebanon Valley R/C Club of Myerstowr PA, and SAM 100—"The Secon

Chance Squadron"—of Lancaster, PA, started the Harry Moyer Memorial Fun Fly on August 27, 1989, and it's held every year. This year, it will be held in late August. Harry's AMA license was 193; a man of vision, he foresaw that the AMA would help young modelers and all those interested in model flying.



The fuselage is used as an assembly jig for the landing gear and the cabane hatch. Stringer placement is not critical. Firewall/motor-mount assembly is at the front. The motor mount must be 3 3/16 inches from the top radius of the firewall.

The Big Pappy "E" ('lectric) will be flown at the 1994 Harry Moyer Memorial Fun Fly. The model is the first reproduction of the original, and it represents the first flying version of this design in more than 50 years. Harry's radio was a Citizenship single-channel, single servo on rudder only, on 27.095MHz.

I have attempted to reproduce the Big Pappy using the original as a guide and making changes as discussed with Eddie Moyer (Harry's son). This is not an aerobatic craft; it's for pilot relaxation and enjoyment. The model's name alludes to Harry's name as a grandfather, Pappy. Two of this design were built—Little Pappy (40-inch wingspan, .049-powered) and, of course, Big Pappy.

I could go on and on about my friend, but we have to build his plane. As you might have noticed, I am one of Harry's followers, of which I am very proud. He is now flying in the great flying field up yonder.

I do not intend to give step-by-step construction instructions because they come with the plans.

WINGS

These take some time to build, so let's start here. The outline and airfoil were taken from the original, which is in the possession of John Moyer, Harry's grandson.

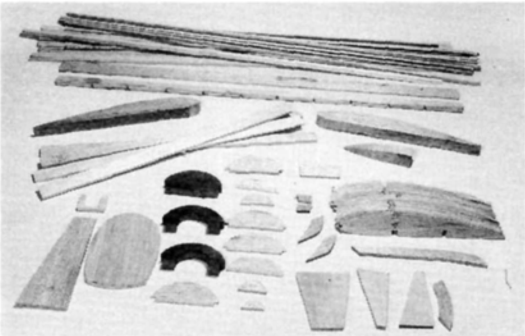
Just a few suggestions: I always make a wing-rib template to help with cutting the ribs. The cutout for the 1/4-inch dowel leading edge was made with a 1/4-inch-o.d. piece of brass tube, the end of which I sharpened from the inside to the outside.

Dihedral is dictated by the cabane and the length of the struts. Strut length can be modified to allow for personal preference in setting dihedral. Drilling the holes for the cabane tube and dowel assembly can be a little tricky. I didn't glue W1 and W2 into position until I had established the dihedral with the struts in position.

The W3 holes are drilled at this time, and the 1/8-inch lite-ply pieces that form the retainer boxes should now be installed. Be sure not to glue the composite carbon-fiber tube assembly to the box. When W1 and W2 have been mated with the cabane assembly to establish the dihedral angle, they are glued to the wing. This makes a nice joint.

The pine or spruce pieces that anchor the struts and hold the wings on the cabane were made out of shelving found lying around the shop. The pieces are the full depth of the wing ribs, and they're attached to and carved to match the airfoil. The pieces anchor the struts and hold the wings by using curtain-rod L-hooks and rubber bands (positions shown on the plans). The positions of the hooks for the bottom of the wing are determined by the cotter pins on the end of the struts. Screw the hooks into the blocks as required. The tips are made of soft balsa that's carved to the shape of the airfoil and rounded to a pleasing shape.

You may have noticed that the 3/32-inch balsa spar supports don't completely span from rib to rib. The choice is yours, but for my type of flying, it isn't necessary. Besides, it saves weight; don't forget: the lighter, the better.



Parts kit. When scratch-building, your first efforts should be directed toward assembling a parts kit. Have everything cut, sanded and ready, and building will go quickly. It's my first step; try it.

SPECIFICATIONS

Type: OT sport flier

Weight: 6.7 lb. (107.2 oz.) ready to fly

Wing loading: 19.5 oz. per sq. foot

Wingspan: 66 in.

Wing chord: 12 in.

Wing area: 792 sq. in.

Wing position: cabane-supported high wing

Airfoil: original—Clark Y type

Dihedral: 2 in. each tip

Fuselage length: 45 in.

Stabilizer span: 28 in.

Stabilizer chord: 8.5 in.—average (including elevator)

Stabilizer area: 228 sq. in.

Stabilizer airfoil section: flat

Stabilizer location: mid fuselage

Vertical fin height: 8 in.

Vertical fin width: 11.25 in. (including rudder)

Rec. motor: AstroFlight geared 40 electric Cobalt

Battery pack: 21-cell 900/1200 Sanyo or 1000 SR mAh

Landing gear: conventional

Rec. no. of channels: 3 (rudder, elevator, throttle)

Materials: balsa, spruce, ply, composite tube

• **Stabilizer.** Follow the plans to the letter, and you won't have any problems. The 1/16-inch plywood inlays for the control horns are a must. Notice that the elevators aren't tied together, but are joined with a Y-yoke pushrod. Clevises on both ends allow the proper adjustments to be made. It works well; try it.

• **Struts.** are copied directly from the original. The use of cotter pins was Harry's trademark, so I use them here. Medium to hard balsa should be used, and the joint should be epoxied. Detail A shows the assembly of components for the three strut ends.

• **Rudder and fin.** These are as shown on plans. Be sure to insert the 1/16-inch plywood control-horn mounting pieces. It's tough to have a control horn completely part company with the plane while it's in the air.

FUSELAGE

Just like a big rubber-band model, the longerons are 1/4 inch square and

Cowl, pine parts and tail-wheel sub-assembly. Be sure the cowl aluminum is soft enough to be formed by hand. Use the firewall assembly as a forming tool.

made of medium to hard balsa. Unless you have 48-inch wood available, you'll have to splice two pieces to make the bottom longeron. Soak the wood in water until it's pliable, then keep it pinned to the plan until it's dry, when it will be of the required shape. The up-rights and diagonals can be made of light to medium balsa. The stringer notches aren't shown on the plans, and I prefer to notch at assembly. Don't install the firewall yet.

Because the ¼-inch sheet filler in the stab area is subjected to lots of stress, it must be reinforced with 1/16-inch-thick plywood, as shown. Position the ¼-inch plywood inserts, but don't glue them. Install the stab and drill the mounting holes, then remove it and the ¼-inch plywood inserts. Install 6-32 blind nuts in the ¼-inch plywood inserts, being careful to depress enough to clear the sides. Then reinstall the stab and bolt it into position. A section of brass tube may be installed in the two stab holes to act as guides for the 6-32 bolts.

BATTERIES AND RADIO GEAR

• **Batteries.** After many months of flying Big Pappy, a need for a hatch to allow access to the battery packs became evident. I tried to make it as functional and easy to construct as possible. Following the detailed drawing should enable you to duplicate my efforts.

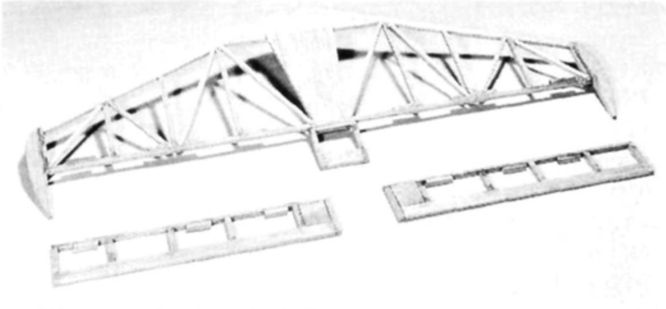
To allow the 21-cell 900, 1200 or 1000mAh packs to be fastened to the removable hatch, I made hooks out of 4-40 bolts that are held in position by washers and nuts. Secured at the front and rear of the hatch, they're used to strap the packs tightly with bungee cord or heavy rubber bands.

After being installed in the hatch, the hooks are bent with round-nose pliers and then covered with heat-shrink tubing.

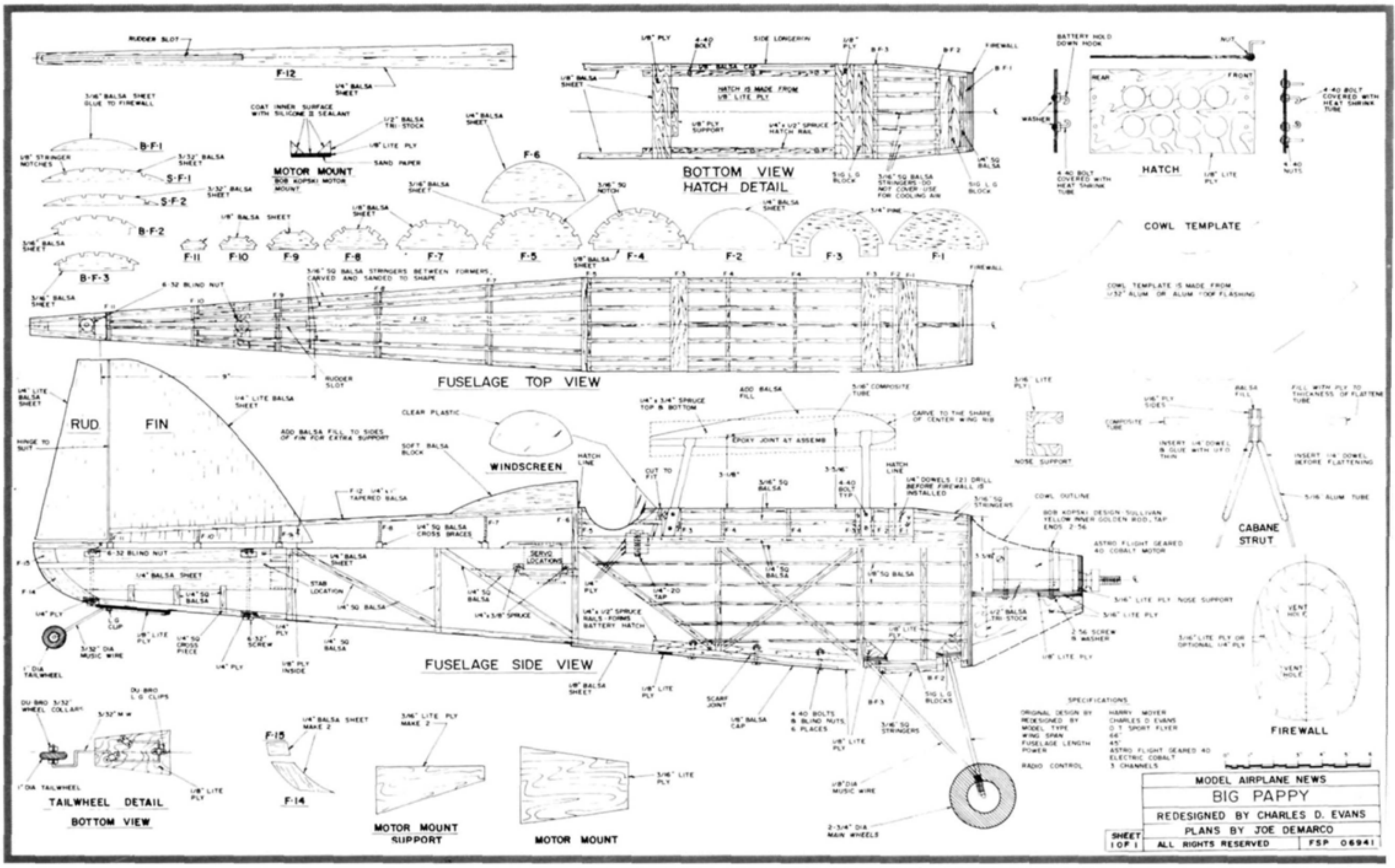
The bay under the servos is left uncovered to allow air circulation, so the holes in the hatch are optional.

• **Radio gear.** An AristoCraft* Challenger FM and the associated servos (standard size) have done an exemplary job of controlling Big Pappy. To facilitate the balancing of the plane and to enhance the size of the battery compartment, the servos are installed behind the cockpit opening in the fuselage. In this position, the speed controller will have plenty of cooling air passing over it through the large vent holes in the firewall. There's plenty of room for the electronic throttle just aft of the firewall.

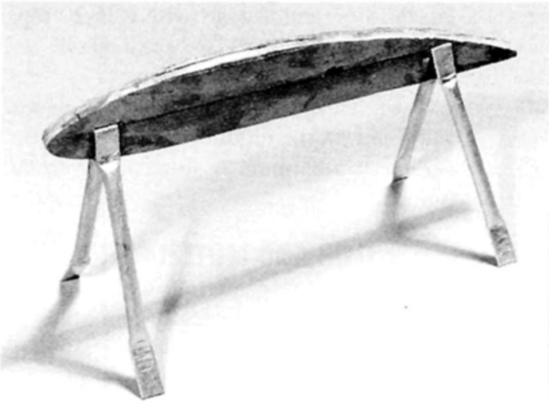
To save weight, I use a 5-cell, 275mAh



Stabilizer and elevators—just like a big rubber-powered job. The ¼-inch balsa pieces at the hinges help them to do their job. Again, notice the 1/16-inch plywood inserts for the control horns.



ORDER THE FULL-SIZE PLAN...SEE PILOTS' MART...FSP06941...$15



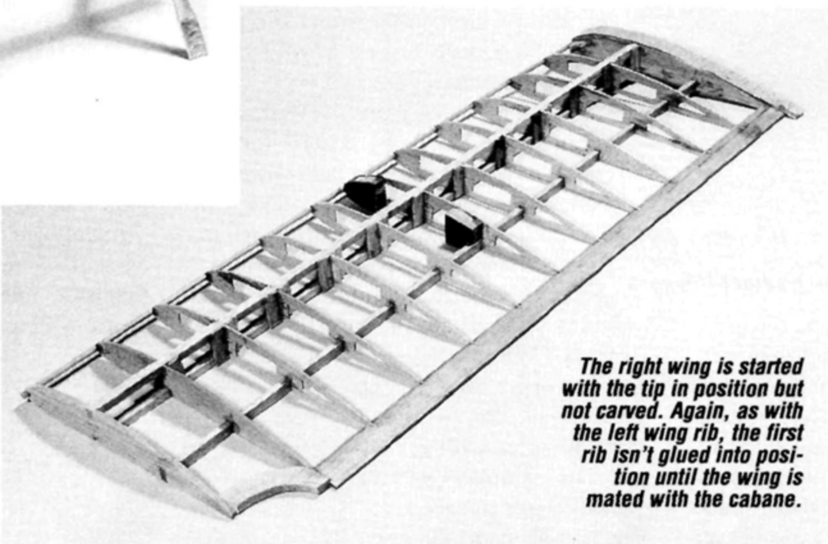
Bent cabane struts are epoxied into the spruce center section. Don't forget the rearward cant of the rear strut. Balsa or ply is used to fill between the struts, and a final sheet of 1/16-inch plywood is glued to each side to finish the job.

battery pack, which is good for about 40 minutes. I re-charge between flights to ensure against failure. Of course, the pack must be recycled now and then to ensure that the batteries are up to snuff.

• **Landing gear.** This is made of bent 1/8-inch-diameter music wire. With some fudging, the outlines on the plans will produce a strong undercarriage. Please note the strut mount at the top of the gear. Install this where it's shown.

All the pieces to be joined were cleaned with sandpaper, washed with lacquer thinner, dried well and then wrapped with copper wire and silver soldered. To save weight, I use light Dave Brown* 2¾-inch wheels.

To install the landing gear, I put the front and rear pieces into the landing-gear blocks in the fuselage. Fastened down with Du-Bro* steel landing-gear straps, this forms a jig for soldering. To help with takeoffs, toe in the wheels about 3 degrees, i.e., as if the main gear were slightly pigeon-toed. There's no steerable tail wheel.

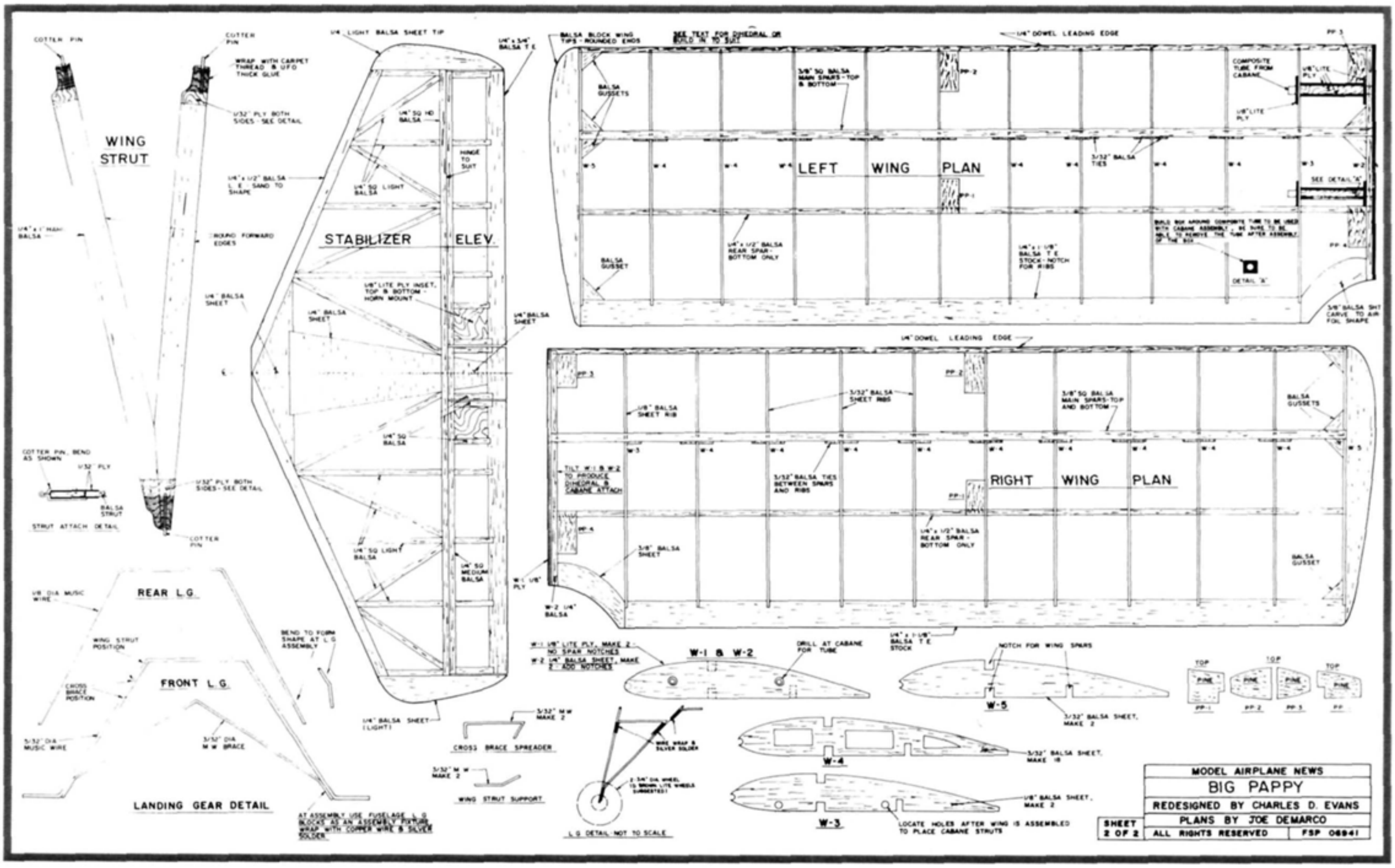


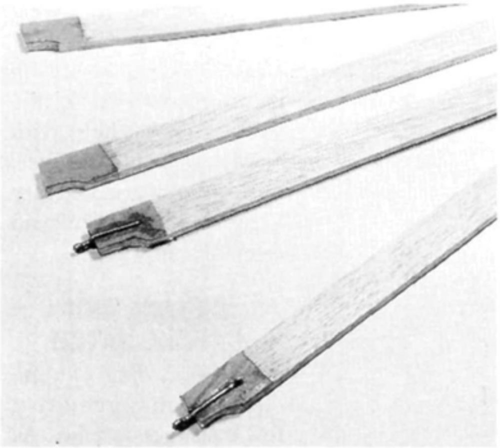
The right wing is started with the tip in position but not carved. Again, as with the left wing rib, the first rib isn't glued into position until the wing is mated with the cabane.

CABANE AND CABANE HATCH

• **Cabane.** The cabane structure may require a few construction hints. As shown in detail B on the plans, the aluminum cabane struts pass through the ¼x1½-inch spruce center. This section is made of two ¼x¾-inch spruce pieces cut to the shape of W1. The secret to doing this is to flatten the 5/16-inch aluminum tube and bend it to shape following detail B.

Insert ¼-inch dowels into the aluminum cabane tubes, glue them fast with thick UFO*, and then flatten the ends of the tubes (see plans). Make front and back struts, then slip both over the lower ¼x¾-inch piece, positioning it as shown on the





Medium to hard balsa wing struts. Strengthen the ends with 1⁄32-inch plywood end braces. The cotter pins are in place and ready for a carpet-thread wrapping.

plans. Notch the top ¼x¾-inch piece to clear the aluminum tube, and epoxy the top and bottom of the two pieces of spruce together. The rear strut has a slight rearward cant to it, so be sure to bend it according to the plans. Fill both sides of the cabane structure with balsa or plywood that's as thick as your flattened aluminum tube. For additional strength, cover the assembly with 1⁄16-inch plywood, and sand as required.

Find the positions of the two holes for the carbon-fiber tubes. Use W1 as a drill guide, being mindful to keep the incidence ratio given on the plans. The forward and aft cabane braces are made in the same way as the struts and held on with wood screws.

• **Cabane hatch.** After completing the fuselage, the hatch is easily built using the fuselage as an assembly jig, because what we're working with is an overgrown rubber-powered model design. Notice the ¾-inch pine or spruce formers. These take the bolts that secure the cabane struts, and they anchor the two ¼-inch dowels that hold down the front of the hatch. Use 4-40 bolts and nuts, two for each leg, drilled through the struts and pine formers. A drop or two of thin UFO anchors the nuts.

Before installing the firewall, drill holes through F2B, F1 and F2 for the two ¼-inch dowels. These hold down the front of the cabane assembly and will have to be adjusted to allow the hatch to slide into and out of position. If neccessary, elongate the bottom of the F2B holes to facilitate the insertion of the dowels. When the hatch works, install the firewall. The rear hold-down assembly consists of three ¼-inch lite-ply pieces. The first fits under the top longeron and is cemented into position. The second fits between the top longerons and is epoxied into position and to the first. Number three fits between the hatch longerons. Do *not* glue the third to the second. Drill all three pieces at once, and tap the first and second with a ¼-20 tap. Drill all three to clear a ¼-20 nylon bolt.

• **Cowl.** This is typical of Harry's planes and a few of the old-timers of this era. Be sure your aluminum is soft enough to be formed.

The fin and rudder. Don't forget the 1⁄16-inch plywood inserts for the rudder. The rest of the building is straightforward.

MOTOR AND MOTOR MOUNT

An AstroFlight* geared 40 Cobalt motor fits the Big Pappy perfectly and helps it reproduce the original flight envelope. Of course, a speed controller must be used to slow it down a bit.

AstroFlight recommends a 13x8 prop with 18 cells, but since I use 21 Sanyo* 900mAh, 1000mAh SR* or 1200mAh batteries, a 13x6/10 works great. This combo gives great flying enjoyment.

• **Mount.** The motor hold-down structure was designed years ago by Bob Kopski. It's simple, effective and reliable. I have been using it since it was first published in *Model Aviation* in Bob's column. It has never failed me, and it has an extra benefit—a quick-release device that's great if you try to land *underground!* The drawings on the plans will help you

MATERIALS

• Wing
¾-inch pine, fir, or spruce
4—⅜x⅜x36-inch medium-hard balsa
2—¼x36-inch dowels
1x3x24-inch soft-balsa tips
12x24-inch sheet of ⅛-inch lite-ply (enough for entire plane)
2—¼x4x48-inch light to medium balsa (enough for entire plane)
4—3⁄32x4x48-inch medium balsa
2—¼x1⅛x36-inch balsa trailing-edge stock
8—L-hook curtain-rod holders
⅛x4x36-inch medium-balsa sheet
2 —¼x½x36-inch hard balsa
Miscellaneous—⅛- and ⅜-inch sheet

• Stabilizer and elevator
4—¼x¼x36-inch light to medium balsa
2—¼x¼x36-inch hard balsa
¼x½x36-inch medium to hard balsa
2—Du-Bro elevator horns
6—Sig* Easy Hinges—
Miscellaneous—¼-inch sheet (see wing); 8x12-inch sheet of 1⁄16 plywood

• Rudder and fin
2—¼x¼x36-inch light balsa
3—Sig Easy Hinges
Du-Bro control horn
Miscellaneous—¼-inch sheet (see wing)

• Fuselage
6—¼x¼x36-inch (or 4, 48-inch) hard balsa
8—¼x¼x36-inch soft to medium balsa
¼x¾x36-inch spruce
2— ¼x8x12-inch lite-ply
12x12-inch .062 soft aluminum sheet
1 set—Sig landing-gear blocks
2—6/32x3 bolts
2 —3⁄32x3x36-inch medium sheet
1x1¼x5¼-inch soft-balsa block (headrest)
⅛x3x36-inch medium sheet
⅛-inch-diameter music wire
1⁄16-inch-diameter music wire
¼-inch wooden dowel
12-inch Sullivan* yellow inner rod
4—2/56 bolts
36 inches of ½-inch balsa
Miscellaneous—¼-inch sheet (see wing);
¾-inch pine, fir, or spruce shelving
8—3⁄16x3⁄16x36-inch light balsa
1-inch Du-Bro tail wheel
6—⅛x⅛x36-inch hard balsa or spruce
3⁄32-inch-diameter music wire
¼x⅜x36-inch hard balsa or spruce
3⁄32-inch music wire
¼x⅜x36-inch spruce
pair—3⁄32 Du-Bro wheel collars
¼x½x36-inch soft balsa
2 pair—⅛ Du-Bro wheel collars
2 sets—Du-Bro landing-gear strips
2—6-32 Du-Bro blind nuts
Miscellaneous—copper wire and solder

• Cabane
¼x¾x36-inch spruce
5⁄16-inch K&S* aluminum tube
¼x36-inch wooden dowel
5⁄16-inch-diameter K&S composite tube
¾-inch pine, spruce or fir shelving
⅛x3x36-inch balsa
8—4-40x1½ Sig bolts
8—4-40 Sig nuts
2—¼-20x1 Sig nylon bolts
Clear acetate windscreen
2—small wood screws
12-inch length of ⅛-inch K&S aluminum tube
8x12-inch piece of 11⁄16-inch plywood
Miscellaneous—balsa or plywood to build up to thickness of flattened tubing

• Struts
4—¼x1x36-inch hard balsa
1 sheet—1⁄32-inch plywood
6—cotter pins, 1¾ to 2 inches long
Spool of carpet thread

• Miscellaneous
Epoxy —Sig 5-minute
CA—thick and thin UFO
Covering plastic film—Black Baron Cut Yellow and Fire Red
Spray paint—Black Baron Fire Red Poly U
Speed controller—Flightec*

to reproduce it without any trouble. (Thanks, Bob.)

COVERING

I covered Big Pappy with Coverite's* Black Baron Cub Yellow and Fire Red. Putting trim on Black Baron material is a snap. I chose this color scheme to match the original, but Harry covered his planes with a cotton material—not unlike handkerchief material—called "Nansook." Our local department store kept it in stock for us. Less expensive, but much heavier than silk, it was applied in a similar way. Dope raised the nap of the cloth, and it had to be sanded.

When you've covered the fuselage, be sure to remove the covering on the bottom just aft of the cabane area. This will allow the air entering the front of the firewall to flow over the speed controller and to keep it and the batteries cool.

BALANCE

Invariably, when you build a plane, one wing half will be heavier than the other, so you must weigh them. It's better to balance them by lightening the heavy side instead of adding weight to the light side. To lighten a wing half, it's convenient to drill holes in its tip.

The CG shown on the plans is the ideal starting point. It's much better to move the motor, the batteries, receiver, airborne pack, etc., around than to add weight. Try to keep the stab incidence as shown on the plans. Of course, individual preference will always be permitted. Position the motor at or close to 0 degrees vertical and horizontal.

PAPPY PERFORMS

Big Pappy will fly on its wings, not on its motor or engine. The tail comes up quickly—hence, no steerable tail wheel. It tracks very well while taking off—not much need for any correction with the rudder. To break ground, Big Pappy may need a little up-elevator. Turns in the air are slow and gentle, so you can putt around in the air having the time of your life.

I guess that's all you need to know to build Big Pappy. It was never intended to be an aerobatic champion, but it was designed for fun. I hope that you enjoy your Big Pappy as much as I enjoy mine. Remember: keep it light; fly quietly; fly electric!

Photography: I thank Andrew T. Lance for his great photos. I'm no photographer, but Andy jumped in, and the results are self-evident.

**Addresses are listed alphabetically in the Index of Manufacturers (for page number, see table of contents).* ■

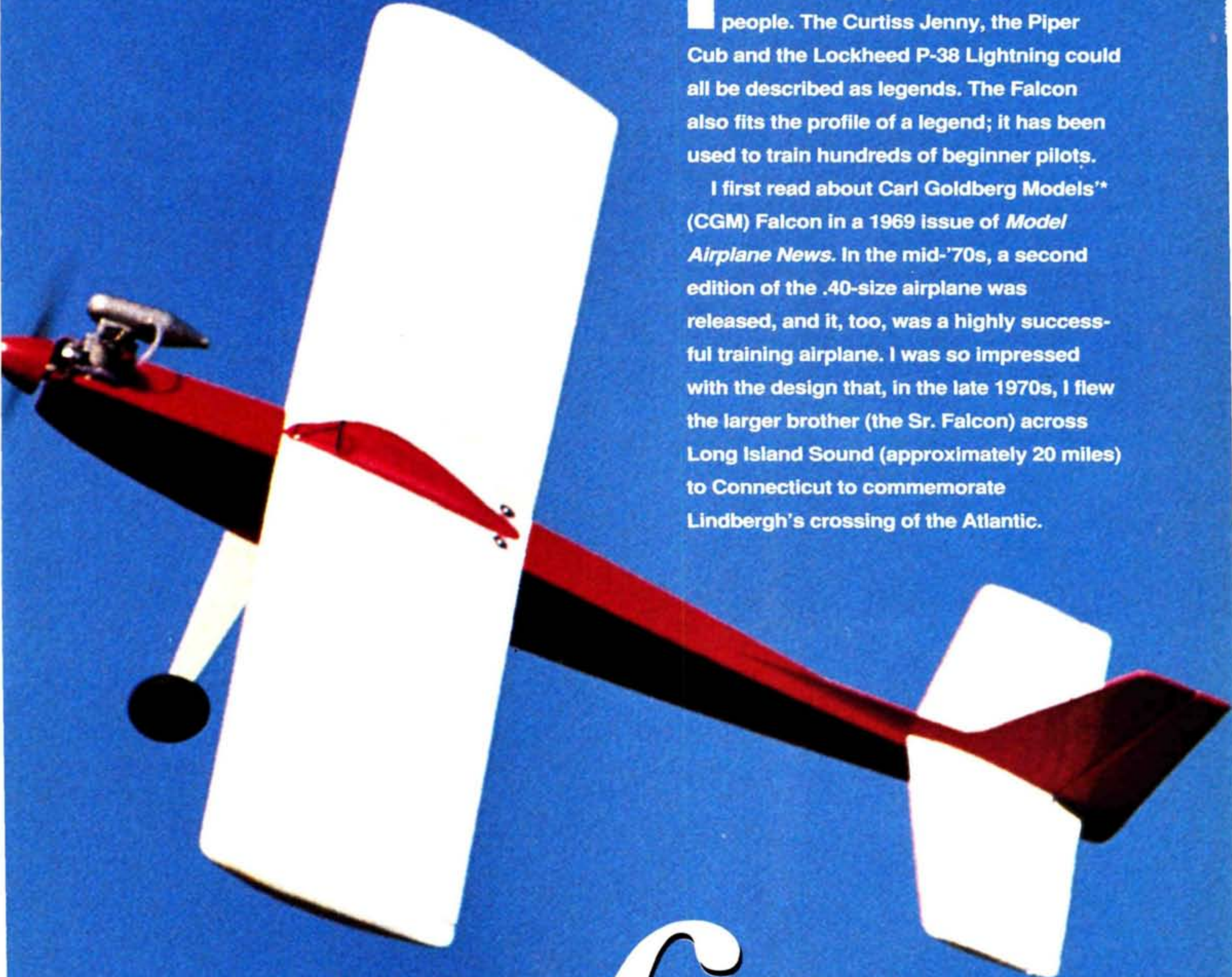
FIELD & BENCH REVIEW

Easier to build and fly, this third-generation sport trainer continues the tradition

falcon III

CARL GOLDBERG MODELS

by TIM DIPERI



IN AVIATION, the word "legend" has different meanings among different people. The Curtiss Jenny, the Piper Cub and the Lockheed P-38 Lightning could all be described as legends. The Falcon also fits the profile of a legend; it has been used to train hundreds of beginner pilots.

I first read about Carl Goldberg Models'* (CGM) Falcon in a 1969 issue of *Model Airplane News*. In the mid-'70s, a second edition of the .40-size airplane was released, and it, too, was a highly successful training airplane. I was so impressed with the design that, in the late 1970s, I flew the larger brother (the Sr. Falcon) across Long Island Sound (approximately 20 miles) to Connecticut to commemorate Lindbergh's crossing of the Atlantic.

FLIGHT PERFORMANCE

• Takeoff and landing

Takeoff and landing are superb with the Falcon III. At full throttle, the tail pops up in moments, and, with a little backpressure, the plane is airborne. (I prefer a conventionally geared airplane for ground handling on rough fields.) During a climb-out, only a little right rudder is needed to track the airplane straight.

Landings are as predictable as can be. The Falcon III can make an effortless three-point landing with no tendency to drop a wing. I deliberately forced the airplane to stall during several landings. It handles very well even when most of the aileron control is impeded owing to the speed. The rudder is very effective, even at low speeds.

• High-speed performance

The planes in the Falcon series have never been considered fast, but the Enya .40 combined with 30-percent Cool Power fuel (distributed by Morgan Inc.*) certainly gave this bird some terrific oomph.

The Falcon III exhibits no unusual tendencies during high-speed straight and level flight. Full-throttle, tight turns are predictable. The airplane won't high-speed stall at full elevator deflection.

• Low-speed handling

The first time I flew the Falcon III, there were some very strong north winds that allowed me to really check this airplane out at low air speeds and to keep the ground speeds to a minimum.

I was able to make the plane hover in 20- to 30-knot headwinds and even "fly backward" comfortably. It has no nasty wing-dropping tendencies. When I forced the plane to stall, the nose lowered a bit, and the plane began to fly again.

I perform all my turns in a coordinated manner, i.e., using rudder and aileron. At low speeds, the Falcon III has a tendency to Dutch roll when I use the rudder. This isn't necessarily a poor feature; it's typical of extremely stable airplanes.

To check the dead-stick handling, I chopped the power at different positions to see whether I could make the field. I found that this airplane has excellent glide performance.

• Aerobatics

Although the Falcon wasn't designed for aerobatics, I did ring it out a bit. It loops and rolls quite well. During loops, no noticeable rudder is needed to track it properly. The rolls, however, require about one-third down-elevator, when the plane is inverted, to keep it level.

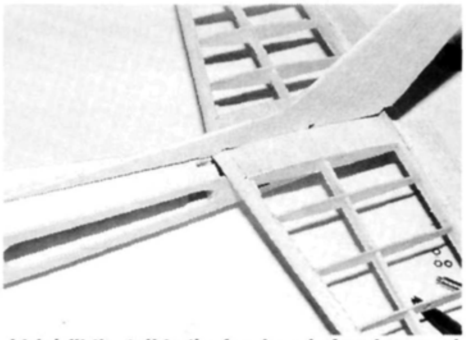
I even tried some inverted flying. A considerable amount of down-elevator is needed to hold altitude. There was plenty of elevator to do inverted circuits.

Recently, CGM introduced a third generation—the Falcon III. It sports many of the lines of the original Falcon, and it's reliable and easy to build and fly.

The horizontal stab seems to be complex, but the leading and trailing edges are notched to easily accept the ribs.

A WALK THROUGH THE BOX

The Falcon III is part of CGM's "Heritage" series. The kit contains cleanly die-cut balsa and light plywood parts that require little sanding. Also included are hinges, screws, nuts, formed landing-gear wire, pushrods and a clear, vacuum-formed canopy. Unlike the older edition of the Falcon, which had wooden rails, the Falcon III has a fiber-filled engine mount.



I trial-fit the tail to the fuselage before I covered them. Notice the notches and the tabs that help you to align the parts.

The kit comes with full-size plans and two booklets. The general information booklet includes important tips on covering the model and installing the radio. The instruction booklet divides construction into a few simple steps.

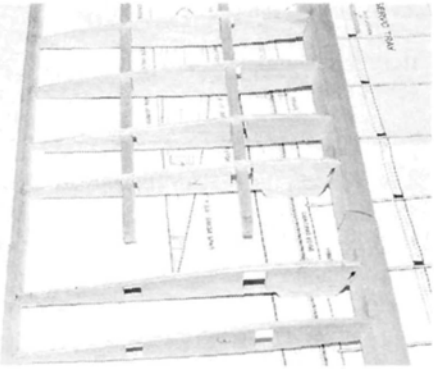
CONSTRUCTION

The tail group is built first. The vertical fin is made by gluing three pieces of balsa together. The Falcon III has a traditional built-up horizontal stab, which is lighter and stronger than a comparable flat balsa sheet stab. The vertical stab is easy to build because the leading and trailing edges are notched to accept the die-cut ribs.

The two, one-piece, light-plywood fuselage sides are glued to the bulkheads and the firewall. The top and bottom sheeting is made of very light, die-cut plywood, and this yields a strong, box-type construction.

The nose-gear mounting holes have been marked on the firewall. Obviously, the engine you choose will determine the positions of the engine-mounting holes. I use an Enya* .40.

The kit contains all the hardware you need to set up the airplane with a tricycle landing gear. To my surprise, CGM also provides instructions for setting up a conventional landing-gear configuration, but the parts needed for this aren't included.

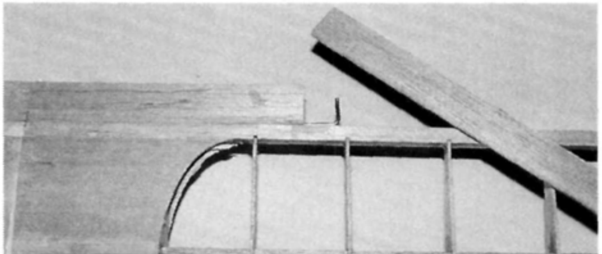


The wing on the Falcon III has the same design as the wings on earlier Falcons. The leading and trailing edges are shaped and slotted for the ribs.

Even though I chose to make my model a conventional-gear (tail-dragger) version, I installed the hardware for the nose gear so that I would be able to convert it later. I used the recommended Klett* fiber-filled main gear shown on the plans.

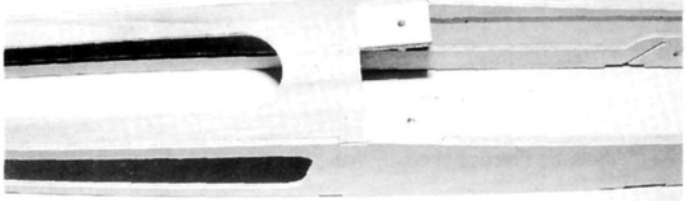
I chose a Futaba* 7-channel PCM radio system with a combination of 5101 and 9201 servos. The kit includes a wooden

(Continued on page 40)



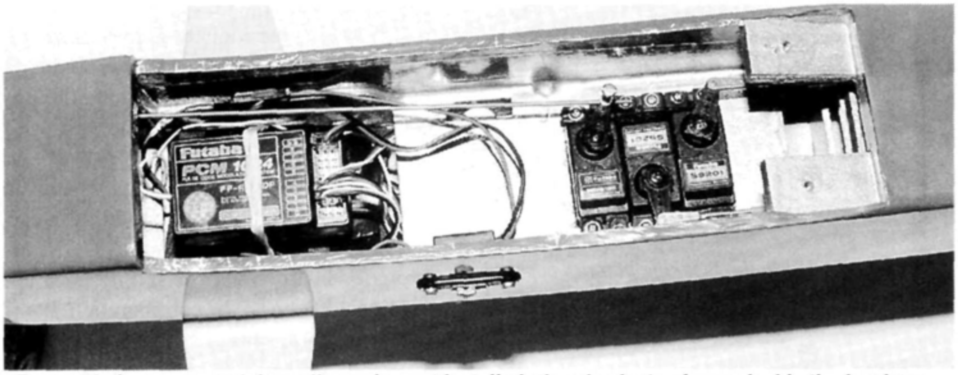
The wing has strip ailerons actuated by torque tubes. The kit includes all the hardware you need.

The Falcon III is straightforward and simple to construct, and it flies well. It's certainly one of the finest training airplanes available.



With its lock-tab fuselage construction and lightweight plywood parts, the model is strong, light and straight.

servo tray. After I had trial-fit the servos and the pushrods, I glued the tray into place. I painted and fuelproofed the entire servo-compartment area, the fuel tank and



Even with the servos and the radio equipment installed, there's plenty of room inside the fuselage.

the engine compartments with two coats of K&B* Superpoxy.

THE WING IS THE THING

The wing on the Falcon III appears to have the same design as the original Falcon's wing. For this I applaud the manufacturer. Why change a good thing? The Falcon's wing has always been considered strong and stable. The only difference is that the Falcon III's wing is bolted down rather than attached with rubber bands. It has a main spar and a smaller rear spar, and the ribs are spaced approximately 1½ inches apart.

The leading and trailing edges are shaped and notched to accept the ribs, which have embossed numbers on them. I constructed the wing halves using CGM Jet CA, and I reinforced each joint with high-quality carpenters' glue. There are five plywood joining splicers for the wing halves. If this wing is going to break, it won't happen at the center section!

Finally, the center section (both top and bottom) is sheeted. (Sheeting is about 6 inches wide.) There's no leading-edge or trailing-edge sheeting, and if you try to twist the wing, you'll see that there's no need for it.

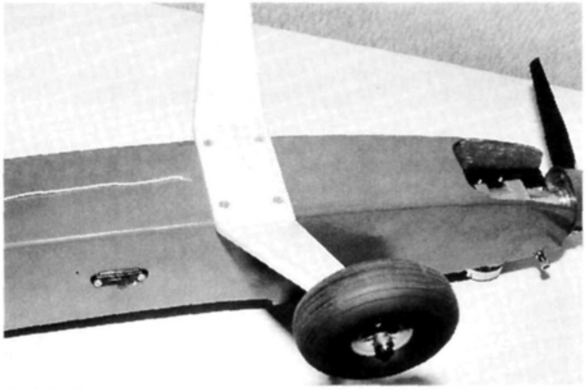
FINISHING

I used CGM's Ultracote covering film. This was the first time I used it, and I found it very easy to apply. The instructions tell you to cover the horizontal fin before you mount it on the fuselage. I also covered the vertical fin and the fuselage before I attached the tail parts. The only trick is to remove the covering material at the glue joints, e.g., where the horizontal stab meets the fuselage, without cutting into the wood and weakening the assembly.

SUMMARY

The Falcon III is straightforward and simple to construct, and it flies well. It's certainly one of the finest training airplanes availabl Its new features and options, e.g., a bolt down wing instead of rubber bands and choice of landing-gear configurations, mak this plane even more attractive than it predecessors.

Although the Falcon III is marketed fc beginners, advanced pilots can have a lot c fun with it. In the past, I've flown modifie Falcons that were built with little or no dihe dral and 6 to 8 inches cut off each wingti These modifications have turned a stabl trainer into a good aerobatics trainer.



In this bottom view of the finished fuselage, you can see the conventional Klett landing gear and the antenna that runs underneath.

**Addresses are listed alphabetically in the Index Manufacturers (for page number, see table of contents).*

SPECIFICATIONS

Model name: Falcon III
Type: sport/trainer
Manufacturer: Carl Goldberg Models
List price: $99.99
Wingspan: 56 in.
Wing area: 558 sq. in.
Weight: 4.5 lb.
Wing loading: 18.58 oz. per sq. ft.
Airfoil: semisymmetrical
Washout built into wing?: no
Length: 46.5 in.
Rec. engine size: .35 to .40
Engine used: Enya .40
Prop used: Master Airscrew* 10x6
No. of channels req'd: 4 (aileron, rudder, elevator and throttle)
Radio used: Futaba PCM
Wing construction: built-up balsa
Kit construction: built-up balsa and plywood

Features: the Falcon III has a simple fuselage construction with single-piece sides; a bolt-down wing; and a built-up horizontal stab. Lock-tab construction and cleanly die-cut, light plywood parts make for a strong, light, straight model. The horizontal stab and the wing have shaped, notched leading and trailing edges to make construction quick and simple. The kit includes all the hardware needed for a tricycle landing gear, but the instructions also show a tail-dragger configuration.

HITS
- Bolt-down wing instead of rubber bands
- Simple, lock-tab fuselage construction
- Landing-gear option
- Substantial hardware package included

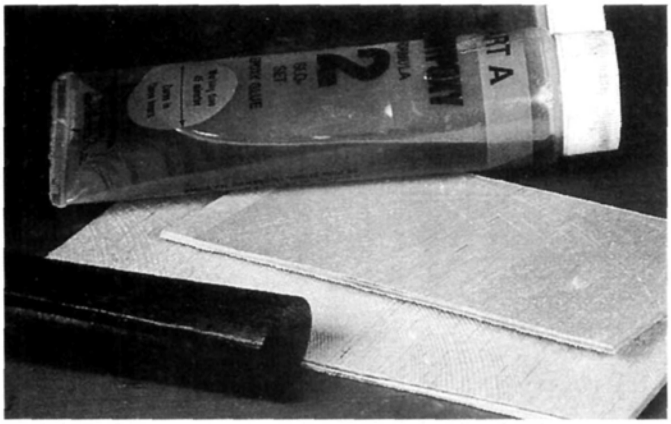
MISSES
- No misses

HOW TO:

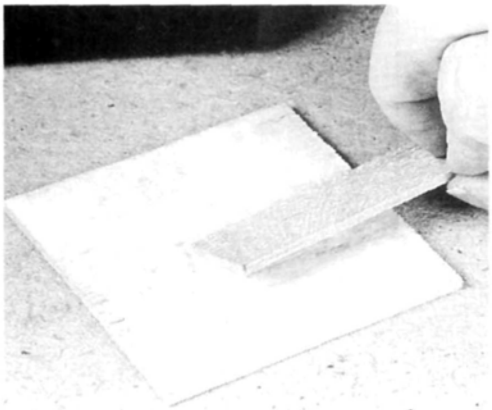
RANDY RANDOLPH

MAKE A STRONG, LIGHT FIREWALL

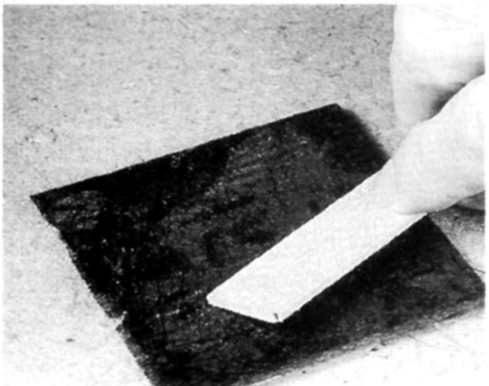
BECAUSE THEY'RE strong and relatively easy to install, plywood firewalls have usually been used for mounting engines on model airplanes. But with the advent of carbon-fiber mat, it's now possible to make lighter, balsa firewalls. Here's how to make an $\frac{1}{8}$-inch-thick firewall that will take more abuse but weigh less than half the weight of the $\frac{3}{16}$-inch-thick plywood it replaces.



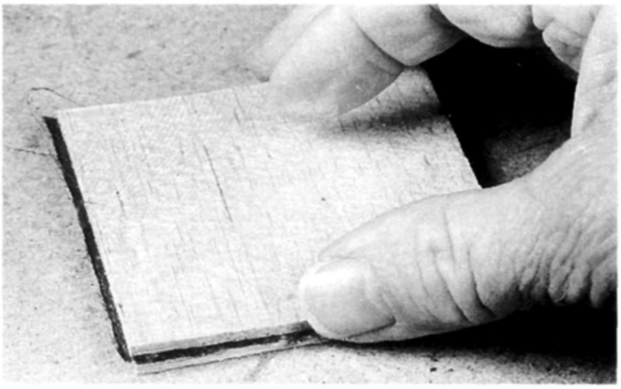
1. You'll need relatively hard $\frac{1}{16}$-inch-thick balsa sheet, 0.004-inch-thick carbon-fiber mat and epoxy cement. (Because it allows plenty of working time, I recommend slow-curing epoxy.)



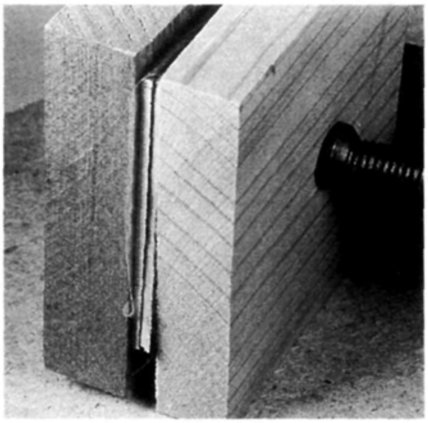
2. Cut two pieces of balsa and three pieces of carbon mat slightly larger than the firewall will be. Cut the balsa so that, when assembled, the two pieces will be cross-grain to each other. Thoroughly cover one of the balsa pieces with a coat of epoxy.



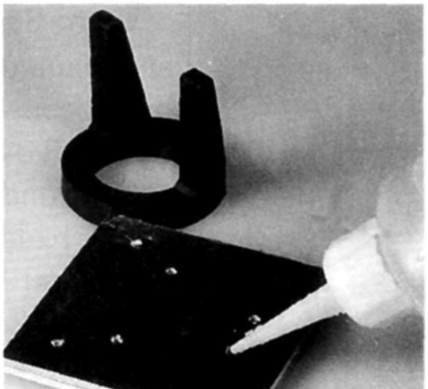
3. Apply a piece of carbon mat to the epoxy, and smooth it into place using a piece of scrap balsa. When the mat is smooth, cover it with another coat of epoxy.



4. Position the second piece of balsa over the epoxy-covered mat, and press it down firmly. (The grain should be 90 degrees to the grain of the first piece.) Now, spread a coat of epoxy over each side of the balsa sandwich, and smooth a piece of carbon mat onto each side.



5. Wrap a piece of plastic wrap—or, better still, the backing off iron-on covering film—around the sandwich, and clamp it tightly between two flat pieces of hardwood. (For a more durable firewall, add additional layers of balsa and mat.) Allow the epoxy to cure completely.



6. When the epoxy has cured, cut and sand the firewall to the proper shape. After you've drilled the mounting holes, add a drop of CA to each one to fuelproof it. Now your firewall is ready to be installed in your airplane. The balsa edges offer an excellent gluing surface.

IN AVIATION, the expression "heavy metal" conjures up a certain idea: authoritative flight performance for those who are willing to take the risks to earn the rewards. Powered with the optional Keller 25/14 motors, the Robbe* Dornier 228 is just such an aircraft; it flies with authority, but it's not for inexperienced pilots. For those who respect the limits of its envelope, the Keller-powered Do228 delivers convincing flight performance. Powered with lighter, less powerful standard 05 motors, the Do228's top speed decreases, but so does its wing loading (see the sidebar, "Power to Weight").

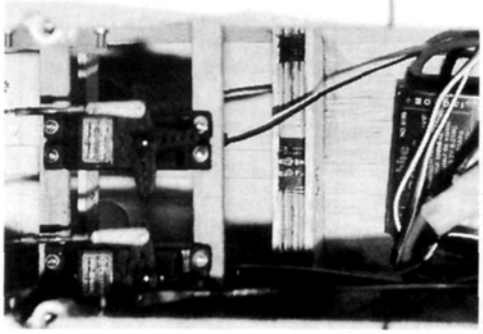
ROBBE *Silent Speed* DORNIER 228

BY CHRIS TRUE

The Robbe Do228 is a scale model of the Dornier STOL commuter liner. Twin electric motors provide reliable synchronized power. Robbe rates its kits according to both building difficulty and flying ability required. On the one-to-three-star scale (one is the easiest), this kit rates two stars in the building category and three on the flying side. Robbe considers the two-star level to require "some building experience" and the three-star flight rating to be "for experts in radio control."

THE KIT

The kit consists of sheet-balsa fuselage sides; stick-balsa tail surfaces; a D-tube wing structure with spruce spars and balsa shear webs; and ABS plastic moldings for hard-to-make items (nacelles, landing-gear fairings, canopy and nose cone). The overall quality is quite good except that some of the parts could have been die-cut more cleanly. I found the instructions to be reasonably complete. There are no photos, however, and the type is very small, so, to avoid getting lost, check off each item as you complete it.



Futaba servos and Robbe's RSC750 electronic speed controller certainly don't test space limitations in the Dornier's radio compartment.

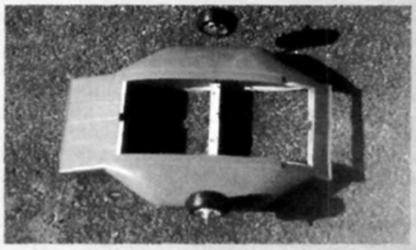
Here are the fuselage and the wing before they were covered.

I was a bit perplexed by the wiring diagram for the motors. There's one diagram in the instructions that has a printing error. Therefore, Robbe includes an addendum sheet with the correct diagram.

CONSTRUCTION

First, I marked every piece of balsa in the box according to the parts layout guide. Robbe's numbering system is a bit unorthodox. For instance, instead of labeling a rib "R-1," Robbe might label it "4.16" (4 signifies the fourth substructure, and 16 signifies the 16th part in that assembly).

Construction is conventional, so I won't go through it step by step, but I will offer a few comments on some of the more unusual aspects. The wing's leading edge is swept back outboard of the nacelles, so



The landing-gear sponson has a sliding hatch that allows access to the battery.

SPECIFICATIONS

Model name: Dornier 228

Type: semi-scale electric

Manufacturer: Robbe Model Sport

List price: $179.95

Wingspan: 59 in.

Wing area: 403 sq. in.

Weight: 6 lb., 4 oz.

Wing loading: 35.7 oz. per sq. ft.

Airfoil type: semisymmetrical

Washout built into wing?: yes

Length: 48½ in.

Rec. motors: two Power 600/19s (no. 4472, $17.50 each)

Motors used: two Keller 25/14s

Props used: two APC 9x8s

No. of channels req'd: 4

Radio used: Futaba

Wing construction: balsa, spruce and plywood

Kit construction: balsa and plywood

Hits

- Sturdy construction.
- Crowd appeal.
- Fast, furious flight performance.
- All hardware is included.
- Excellent battery-mounting position; in a crash or hard landing, the slide cover pops off, and the battery falls from the airplane without causing damage.

Misses

- Short flight time.
- The wiring diagram is incorrect, although an addendum corrects this.
- The windshield is made of very brittle plastic that cracks easily.

FLIGHT PERFORMANCE

I made the test flight on a perfect, sunny, 80-degree day. I had some apprehensions about flying the Do228 because of its wing loading of 35.7 ounces per square foot (see analysis in "Power to Weight" sidebar).

• Takeoff and landing

After a few miscues owing to a nose-gear problem, the Do228 accelerated briskly down the 300-foot paved strip. Keeping in mind its high wing loading, I let it run along most of the strip before rotating for takeoff. Rotation and climb-out were anticlimactic, and very little trim was required—fewer than five clicks on both the elevator and the ailerons. This plane has a very solid feel to it, and it tracks like a Patriot missile.

The Do228 requires from 50 to 100 feet of takeoff roll on blacktop, and, with the Keller motors humming on APC* 9x8s, it climbs out in an impressive manner. Landings are surprisingly tame. I fly a high pattern, carrying full throttle until I turn onto base leg, then I cut back to half throttle. After turning onto final, I cut throttle back all the way while keeping the nose down to maintain a healthy air speed. Once the plane is about 12 inches off the runway, I level off, and the speed quickly drops off for touchdown. Keep in mind that the Do228 requires a good rate of speed to stay in the air, and it has a large fuselage that creates lots of drag. So keep the landing approach steep and the speed up.

• High-speed performance

The Do228 is at home when it's moving fast, and it has very smooth high-speed flight characteristics. You must, however, be careful with very tight, pylon-racing-style turns because this model will snap out of a high-speed turn that's executed too tightly.

• Low-speed performance

Because of its high wing loading, the Dornier's low-speed performance has its limitations. Although its stall speed is on the high side, the model is surprisingly well-behaved. For example, when taking off grass on one occasion, I pulled a bit too hard on the elevator to get the nose wheel off the ground. The model leaped off the ground and started to tip-stall. As soon as I got off the elevator, the model instantly straightened out and kept flying. The plane will warn you when you're about to mess things up. Just keep in mind, this isn't a floater.

• Aerobatics

This isn't a pattern ship, and it wasn't designed to be. It does, however, roll like a Great Planes'* ElectroStreak (very axially) and tracks on a heading much like a pattern plane. Top hats and figure Ms are simply not in the cards for this model, or for most other electric-powered models. It's best to steer clear of any high-G, gut-wrenching, maneuvers. Needless to say, it will spin. The Do228 likes to fly fast and smooth. If you're pulling any Gs, make sure you're flying fast.

• Conclusion

After flying the Dornier 228 at contests for two seasons with two Keller 25/14s, I met the Robbe sales representative, Peter Oesterwinter, at the 1993 KRC Electric Fly. In his model, he had installed two stock 05-type motors, as recommended in the instructions. I was quite surprised at how well his plane flew with them. Each one is approximately 4 ounces lighter than a Keller 25/14, and this decreases the wing loading by almost 3 ounces per square foot and reduces the plane's landing speed somewhat. This combination will not drive the plane to the same high air speeds as the Kellers, but the handling characteristics are more forgiving. The only drawback is the slower takeoff performance; takeoffs from grass are sluggish at best. Pavement is the surface of choice. So if you're interested in building this plane, take your choice: the Kellers for the highest performance, or the ferrite 05s for a cheaper alternative and lighter wing loading.

• • • • •

Power to Weight

I always crunch the numbers on an electric plane before I fly it, so I'm sure that if it doesn't fly, it isn't because the power isn't there. Watts per pound is an excellent predictor of performance, and usually, a level of 40 to 60 watts per pound is sufficient to ensure good performance. With the 8x6 props recommended by Robbe, the Keller 25/14s drew 24 amps combined for an output of 336 watts (24 amps x 14 cells). The plane's final weight was 6.25 pounds for a power/weight ratio of 54 watts per pound. Was I comfortable with this? No! Why not? Read on for the rest of the story.

Model aviation is a continuum of designs whose power requirements range from low to very high. No rule of thumb will hold true for all aircraft, so if you have an airplane that falls outside the broad middle range of design features—whether it be aspect ratio, drag, or wing loading—more analysis is required. The Dornier Do228 falls outside the middle range owing to its high wing loading of 36 ounces per square foot, so another formula is required.

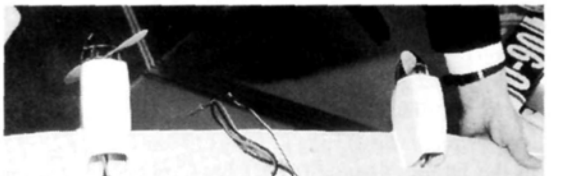
The power required to maintain flight equals wing loading (in ounces per square foot) times weight (in pounds). For our plane, this is 36 x 6.25 = 225 watts required to barely maintain flight. To put this to use, we need to compare it with the available power. I recommend at least a 2:1 ratio for the test flights. In our example, the ratio is 336 / 225, or 1.49. To improve the situation, I tried APC 9x8s, which drew 16 amps per motor, or 32 combined. I applied the formula: 14 cells x 32 amps = 448 watts, and 448 / 225 = 1.99—close enough. Flight tests proved that this was an excellent choice. With 9x8s, I had enough power for worry-free takeoffs and for flying the circuit; throttling back extended the flight. The Do228 would have flown on the 8x6s, but they wouldn't have provided the reserve power necessary in case of a less-than-perfect takeoff or some other flight emergency.

you have to trim the sheeting accordingly. I drew some extension marks on the plan to help me do this.

Robbe provides some excellent bellcranks with built-in differential for aileron actuation. In the past, I haven't had much luck with bellcranks, but these give a solid, no-slop link with the aileron servo. Before you close up the wing sheeting, don't forget to run the wiring for the motors. The kit comes with some nice, high-flex, 12-gauge stuff. A final wing "tip" (ha, ha): the tip blocks are quite thin and fragile at the trailing edge, so I slotted them using a razor saw and glued in strips of $\frac{1}{64}$-inch ply to avoid hangar rash.

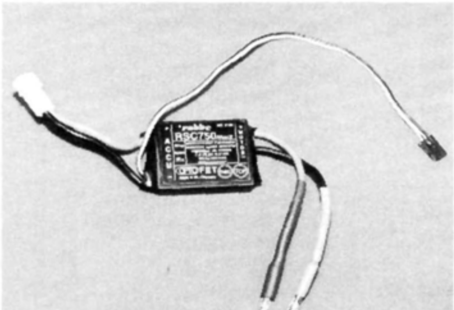
I built all the bulkheads for the fuselage at once to get this tedious chore out of the way. (Each former is made up of four strips of wood.) The most critical task, from an appearance standpoint at least, is fitting the canopy to the rest of the fuselage. The problem is that the fuselage sides are $\frac{1}{16}$ inch thick, and the instructions tell you to glue a strip of spruce onto the back so that half of the strip projects outward to act as a shelf for the canopy. But the canopy is only about $\frac{1}{32}$ inch thick, so use a scrap strip of plastic or $\frac{1}{32}$-inch-thick balsa to adjust the fit. I trimmed all the plastic pieces except the windshield to shape using the "score and bend" method. This type of ABS plastic is very easy to work with and can be glued easily with CA or a solvent-type plastic cement. Because it's a bit more brittle, I shaped the canopy by making a number of small cuts using scissors. After I had filled the seams with automotive-body filler, I used Testors* enamel to paint the plastic parts.

I used Super MonoKote* to cover the Do228. Of all the iron-ons I've used, MonoKote provides the best torsional rigidity and durability. It may be a little harder to apply, but the effort is worth it. The kit includes three small wheels as well as wheel collars, clevises, pushrods, control horns and all the required nuts and bolts—nice!



Above: covered wing with vacuum-formed motor nacelles in place. Left: the bellcrank assembly is slop-free and of very high quality.

The Keller KE-25/14 motors gave the Dornier much added "zap," but are definitely not required. Standard 05s will do quite nicely.



Robbe's RSC750 high-load-handling speed controller is fitted with an MC-2 gold-plated connector and is compatible with six to 21 cells.

RADIO AND MOTORS

Because the fuselage is wide enough for two 7-cell packs, side by side, the radio installation is a snap. I used a Futaba* S-33 servo for the rudder and elevators and an S-148 for the ailerons. Robbe recommends its RSC750 speed controller and two Keller 25/14 motors with neodymium magnets. The speed controller is a very slick unit that has a high pulse rate, a brake, opto coupling and thermal protection. It has a range of six to 21 cells and a realistic max continuous current rating of 50 amps.

Keller motors come in a huge range of sizes and armature winds. For instance, this 25-series motor can be purchased with a 4-, 5-, 6-, 8-, 10-, 12-, or 14-wind armature. The 25/14s I use are very versatile motors; they run comfortably on anything from an 8x6 on 16 cells to a 14.5x7 folder on 10 cells. To install the motors, simply drill the two bolt holes and the center bearing clearance hole in the firewalls, and secure each motor with two M4 bolts.

CONCLUSION

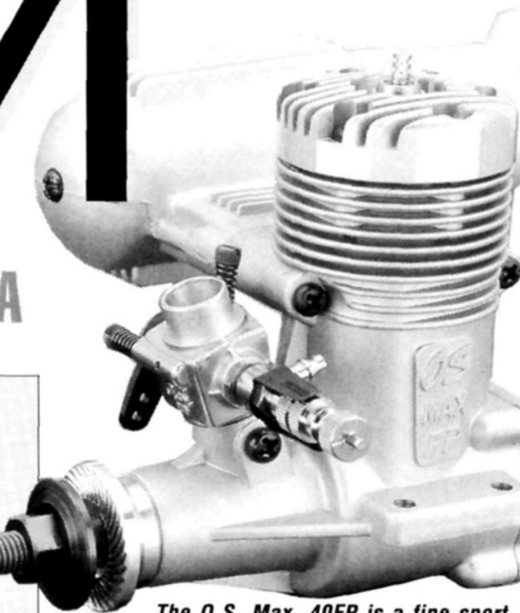
This was a satisfying project. I can recommend this plane with these caveats: a hard surface runway and a high level of piloting ability are required, and flight times will be short—2½ to 4 minutes. The Robbe Do228 makes high demands on the pilot and the equipment, but even jaded gas fliers will be impressed by its flight performance.

**Addresses are listed alphabetically in the Index of Manufacturers (for page number, see table of contents).* ■

RPM

by DAVE GIERKE

READERS' Q & A



DURING THE TIME that I've been writing "RPM," I've found that this work has many sides to it. One of the more interesting facets is the feedback I get from my readers. Many have taken the time to write, giving this column a very positive response. Most also have a question or two. Editor Tom Atwood and I decided that many others probably have similar questions, so we're devoting this month's column to some of them in the hope that the answers will be of interest to you.

The O.S. Max .40FP is a fine sport engine that's intended to be operated without a tuned-pipe exhaust system. It's best to run it with the stock muffler.

TO PIPE OR NOT TO PIPE

A friend built a Sig* Kougar. We bolted on an O.S.* Max .40FP and flew the model with a stock muffler. The plane was docile with moderate take-off acceleration and vertical speed. The prop is a Master Airscrew* 10x6 with alcohol/castor-oil fuel (80 to 20 percent). Some time ago, I wrote to O.S. and asked if this motor could be used with a pipe. The fine people there said, "No, this is a sport and beginners' motor; a pipe is completely inadvisable." Well, because of experience and curiosity, we put a Brazilian muffled pipe on the O.S., anyway. The rpm jumped from 10,000 to 13,000! Can you believe it? The model now accelerates like a "tiger," and the flying speed is almost 30 percent greater. The model seems to be powered by a hot .40 like the old-style O.S. .40 FSR. The only change in the engine is its fuel consumption; it went up a lot!

Do you think we should take the pipe off to avoid damaging the motor, or is our "experience" right?

Also, is it true that only Schnuerle-ported motors can be boosted by a tuned pipe? What does Schnuerle refer to? Can you tell me a little about it, since there are no available references? Also, what does the term "PDP" refer to in relation to ports?

Carlo Adriano Marceddu
San José, SC, Brazil

A tuned pipe increases fuel consumption dramatically but, more important, it also increases cylinder pressures. These greater forces increase engine performance, but they may lead to premature wear on internal engine parts. If your engine manufacturer doesn't recommend the use of a pipe, don't use one.

Carlo, the factory's response to your suggestion to use a tuned pipe isn't unusual. Although you experienced a nice performance increase by using a pipe, it comes at a price. First, as you discovered, fuel consumption increased dramatically! Second, and of greater importance to the factory, cylinder pressures will also increase. This results in greater forces being transmitted through the engine's piston, wristpin, connecting rod and crankpin. The increased torque (twisting force) places elevated loads on the crankshaft, which is bushed rather than ball-bearing-supported. The factory is probably concerned about premature wear and perhaps catastrophic failure of a component that wasn't designed for the overload. If such a failure occurs, certainly, your warranty would be voided. It has been my experience that engine manufacturers know what they're talking about. If they say "no" to performance-enhancing technology, it's for a good reason.

As for your second question: any style of cylinder porting can be aided by using a tuned expansion chamber (pipe), if it's properly designed and adapted to meet the operational requirements of the engine and the correct load (prop) for the intended rpm range.

Today, Schnuerle porting is almost a generic term used to describe multiple transfer passages through the cylinder sleeve. Originally, a German, Dr. Schnuerle (a pre-WW II motorcycle-engine experimenter), proposed the use of two opposed main transfers aimed upward (toward the head) and away from the exhaust port between them. His original system has been supplemented with additional transfers and "boost" ports between the original transfers (opposite the exhaust); these ports are steeply angled upward, toward the head. Some modern engines have as many as seven or more ports, including the exhaust.

PDP (Perry directional porting) consists of small angled ports added to the sleeve of conventional cross-flow scavenged engines. These were designed to supplement and direct the gas flow from the system's original, single transfer port. First developed in Italy, PDP is seldom used today because most manufacturers have switched to the more efficient multiple-port Schnuerle technique.

Your questions about porting and the lack of a good reference really hits home. I'm currently working on a book about 2-stroke glow engines

that will answer all of these questions. It should be available by the end of the year. DG

ONBOARD INFO

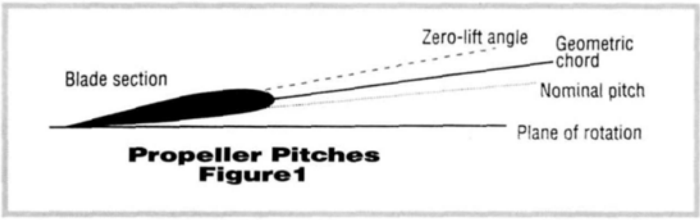
I'm in the process of bread boarding an rpm telemetry system using the Ace* Thermic Sniffler and the Ace tachometer—combining the systems for rpm indication. If possible, I would like to build (or purchase) an air-speed, rpm telemetry system like the one you have on your Airtrax* model. The system has great application in setting tuned pipes vs. propeller size.

Emory Frey
Duncan, OK

Emory, my original system was purchased from Condor R/C Specialties and was called the Digicon Tele Tachometer Model TT-01. Unfortunately, it has been discontinued. They ended production just after I started writing the "RPM" column in 1992—talk about bad timing! The Digicon works nicely. Rpm are sensed via photocell, as with modern light-reflective tachometer units. The air-speed sensor uses the same photocell, operating with a freewheeling miniature propeller that had been calibrated in a wind tunnel. The handheld receiver uses an analog meter that indicates rpm and air speed. The air-speed scale reads in km/hour, which I convert to mph—a minor inconvenience.*

The latest unit that I'm experimenting with is the R/C Talker, also distributed by Condor. Mr. Bill Neumann and his group have designed a unit in which a calm female voice delivers a running series of air-speed and rpm numbers.

The Talker's air-speed sensor is of the pitot-tube variety, which should produce reliable high-speed data. Rpm are sensed by a photocell, as with the Digicon unit. It's a nice, professional unit that sells for about $400. DG



Propeller Pitches Figure1

PROP SLIPPAGE

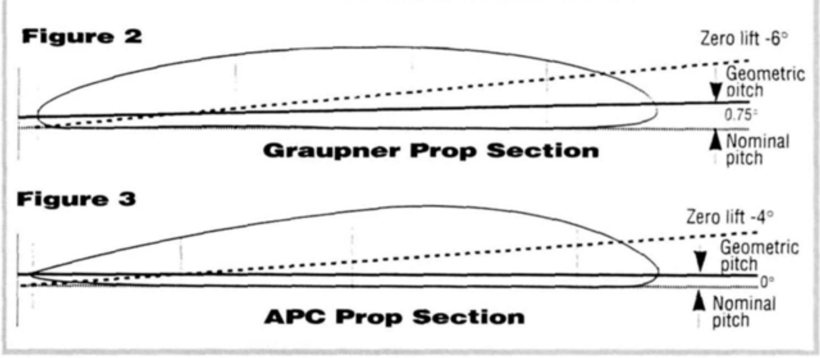
In every feature of "RPM," I notice that there's always a disagreement between true air speed (mph) and air rpm. Could you tell us why the prop pitch speed is less than the air speed? We expect the prop to slip; you seem to experience efficiency higher than 100 percent!

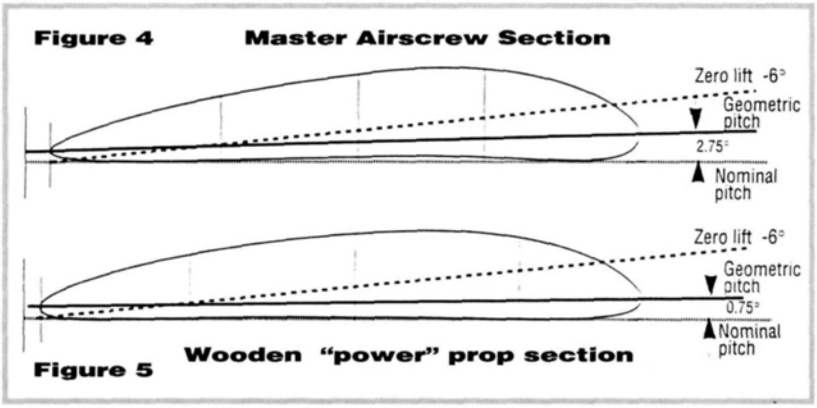
A. Budiharto
Jakarta, Indonesia

Your comments concerning the prop pitch speed not matching the model's air speed are quite timely. It concerned us, too. The first thing we checked was the accuracy of the telemetry equipment, and I found everything in acceptable working condition. It appears that the problem arises with the method in which propeller pitch is measured, compared to the results it delivers.

My friend and fellow columnist Andy Lennon answered this question nicely in his article, "Estimating Level Flight Speeds" (February '94). He wrote, "The big surprise was that the advance per revolution exceeded the prop's nominal pitch anywhere from 7 to 18 percent. For the actual advance per rev to exceed the nominal pitch advance, the blade's actual angle of attack must be somewhere between the 'nominal pitch' and the 'zero lift' angles. The nominal pitch is measured with a pitch gauge, on the blade's rear surface, at a point that's 75 percent of the blade's length, measured from the prop's center. The blade's airfoil, the leading-edge radius and its position relative to the nominal pitch all have a bearing." Essentially, our propellers are operating at a higher pitch than we are measuring with a pitch gauge. You may want to consult the February '94 issue and read Andy's entire article. DG

PROPELLER AIRFOIL SECTIONS





OPERATING TEMPERATURES

Model Airplane News has improved tremendously under its new editor, Tom Atwood, and your extensive, practical engine testing is one of those welcome improvements. I eagerly await the new measurements and fresh data you've promised for exhaust-gas temperatures and cylinder-head temperatures. What are typical, normal values? What are extreme, abnormal values? How will those temperatures vary as functions of engine design, fuel and operating conditions? As data accumulates, will useful patterns, relations, interpretations, engine-design guidelines and engine-operating guidelines emerge?

Greg Krol
Long Beach, CA

Greg, I wish that my temperature measurements would answer even a few of your very comprehensive questions! Actually, the temperature measurements that I'm retrieving are intended to make my dynamometer testing procedure more reliable. Cylinder-head temperatures are used so that torque data acquisition can be

made at the same temperature for each of the many load rpm required to run a complete engine test. When the engine is heated to the same level for each load, similar piston/cylinder expansion can be expected—one of the most important considerations to be accounted for, if repeatability is an objective. I merely watch the head temperature climb, and at 425 to 450 degrees Fahrenheit, I make a final adjustment of the primary needle valve and record torque.

The accurate final adjustment of the needle valve is very important, and I've "missed" the setting more than I care to admit. Watching the tachometer doesn't tell you when the mixture is lean. Cylinder-head temperature is too slow in reacting. Exhaust-gas temperature changes occur quickly, allowing me to get the needle setting right—the first time. What I'm looking for is the highest rpm at the lowest gas temperature. This condition produces the maximum power air/fuel ratio for any given hydrocarbon fuel. So, repeatability and accuracy lead to reliable numbers—one of my main goals!

A discussion of normal and abnormal cylinder-head temperatures along with fuels, lubricants, operating conditions and guidelines will be covered in a future article. DG

BIGGER CARBS

I was greatly impressed by your extensive review of the Magnum .36, distributed by Global Hobby Distributors, in the February '94 issue, so much so that I bought a Magnum .46 to put in a Great Planes* F-15, also reviewed in that issue. Your comment on the "very conservative" venturi (.280 inch) on the .36 made me wonder, so I checked further. The Magnum .46's venturi is only .295 inch. For my non-competitive flying, I wonder if increasing the venturi diameter, say 10 percent, without upping the nitro content and adding a pipe would make a significant improvement?

David S. Coles
Zellwood, FL

David, if you increase the venturi diameter from .295 to .325 inch (10 percent), the bore area will increase by about 21 percent. If you're willing to sacrifice some throttle response and possibly a few hundred rpm at low idle, the change will probably work. Be advised that the hole through the carburetor barrel will also have to be enlarged to .325 inch.

Because the engine's air/fuel flow characteristics will be altered, a change in the torque curve will probably occur. This affects horsepower, since it's a function of rpm and torque. The engine will probably have a tendency to turn smaller propellers at a higher rpm, while low-rpm torque and its capability to turn large propellers may be adversely affected. Only a "before and after" dyno test can tell you for sure.

Increasing the venturi diameter by 10 percent will increase the bore area by about 21 percent. Increasing venturi size may improve top-end performance, but you may sacrifice throttle response and possibly a few hundred rpm at low idle. Changing the air/fuel flow characteristics may also change the torque curve of an engine. Remember that engine modifications simply may not work; you may only increase your supply of scrap engine parts!

It might prove helpful to increase the venturi size in steps (.010 inch at a time?), noting the change in rpm on a common test prop, along with its operating characteristics, i.e., throttle transition from idle to wide open.

I would be remiss if I didn't warn you that scrap parts are a common result when experimental procedures such as these are employed. You might find, for example, that a .325-inch-diameter carburetor necessitates more fuel pressure than the muffler can deliver. Are you prepared to install a pump, with its added cost and complexity?

When all is said and done, I must discourage engine modifications of any type, unless restoration to the original condition is possible, i.e., adding or removing cylinder head shims. With the high price of engines, why take the chance? The Magnum (Pro) series of engines performs really well—just as they are! Your .46 could possibly be better, but let the so-called experts make the mistakes! DG

Remember, if you have comments, suggestions, or questions regarding the material covered in "RPM," drop me a line at 251 Danbury Rd., Wilton, CT 06897. I promise to answer your letter, but I will warn you that it sometimes takes me a while to get through all of them. If you do want a reply, it's a big help when you include an SASE. Thanks!

**Addresses are listed alphabetically in the Index of Manufacturers (for page number, see table of contents).* ■

HOW TO

Set Up Biplane Wings

by ROY DAY

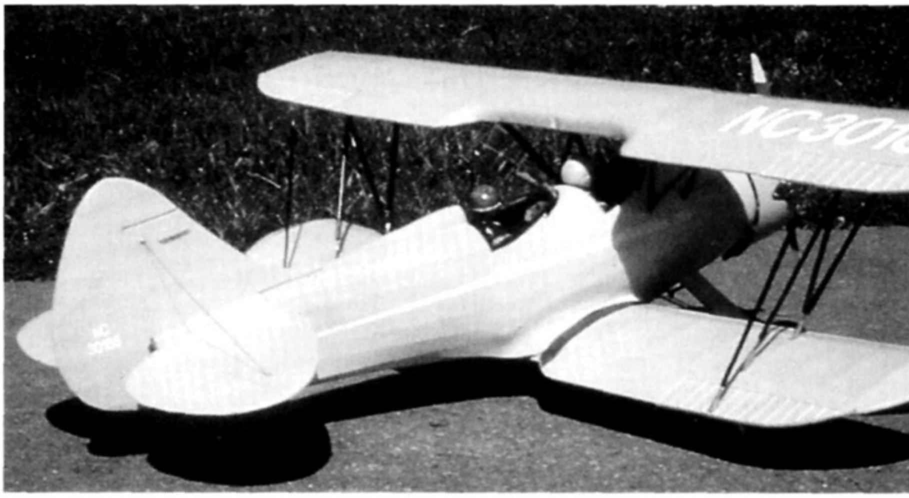
MANY MODELERS shy away from building a biplane for three reasons. They think: building the wire cabane struts is beyond their skills; aligning the wings to the proper incidence requires the skills of a rocket scientist; and a biplane is only for expert pilots.

The purpose of this article is to illustrate step by step how to build the cabane struts and how to align the top and bottom wings. As far as flying skill is concerned, if the biplane was designed correctly and has a reasonable wing loading (say 17 to 22 ounces per square foot), it can be as easy to fly as a monoplane. The sometimes reported "squirrelly" behavior of biplanes is usually the result of an incorrectly positioned CG (too far aft) and/or improperly aligned top and bottom wings. Both problems are easily corrected.

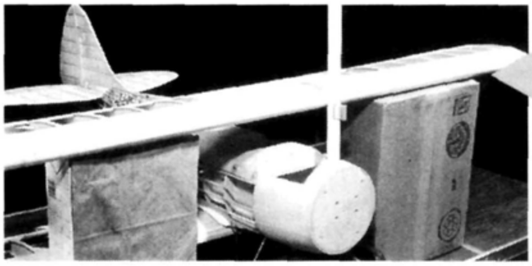
The photo-illustrated steps to set up your biplane assume you are scratch-building. If the biplane is a kit, the procedure is simpler because the wire cabane struts usually come bent to the correct dimensions. You still have to solder them and check the wing incidences.

Build a biplane as your next project, and follow the steps outlined here to make the cabane struts and to align the wings. You will be surprised at how easy it is. And you will be pleased when you show off your new biplane to all your flying buddies.

Getting the incidence correct is easier than you think

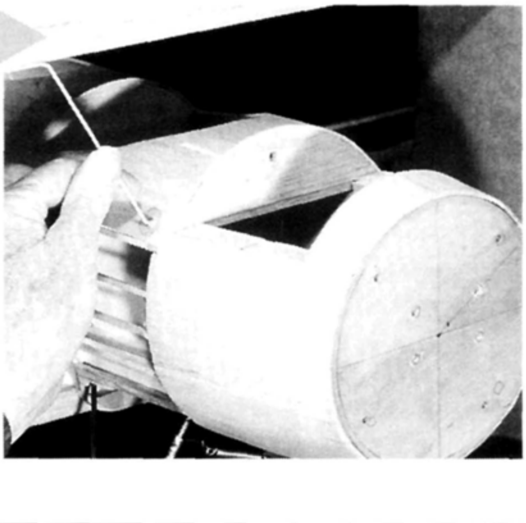


Here's my O.S. .70 Surpass FS-powered Waco UPF-7 bipe, which was set up as described in this article. It has a 56-inch wingspan, weighs 8 pounds and has a wing loading of 21.5 ounces per square foot. The model is an excellent flier, and its wing incidences required no further adjustment.



1 *To make it easier to take measurements, set up the model on a level table. With the bottom wing installed, jig up the fuselage so that it's level. Now support the top wing (cardboard boxes are shown) to the correct height above the fuselage by measuring from some reference point on the fuselage. If you aren't going for precision scale, accuracy to ± 1/4 inch is probably good enough for a 60-size biplane. To check that the wings are parallel in the span-wise direction, measure the distance between the wingtips.*

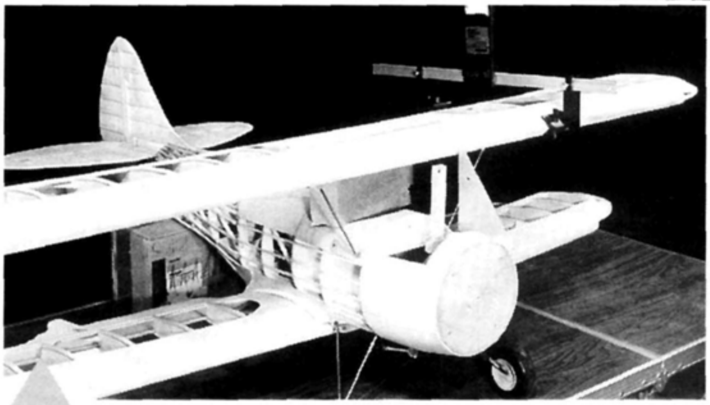
2 *Position your jig supports so that the top wing is in the correct fore and aft position. On both sides, make dummy forward struts by bending a piece of coat-hanger wire that will reach from the forward fuselage attachment points to the top wing attachment point. Use the coat-hanger wire as a pattern to bend your music wire to the same angle and length. Solder on the required end fittings. In the case shown here, the fuselage ends of the struts slide into brass tubes in the fuselage. The wing attachment end is a solder lug. The lug is fastened to the wing with a nylon bolt that goes into a threaded block in the lower surface of the top wing.*



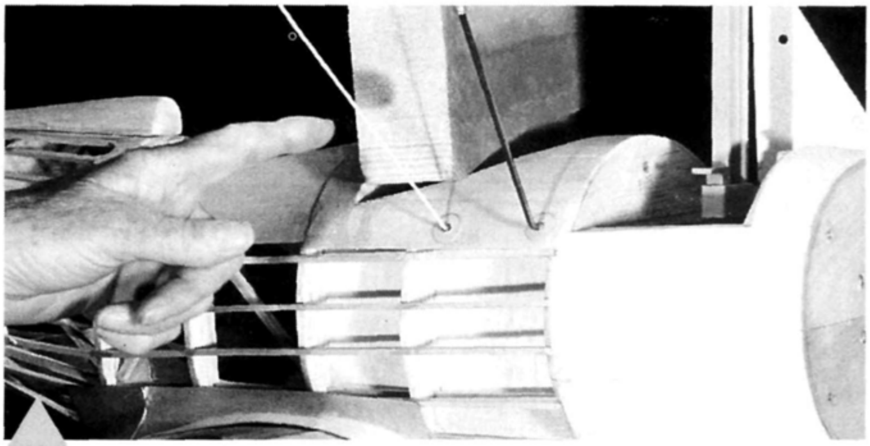
PHOTOS BY ROY DAY

MATERIALS

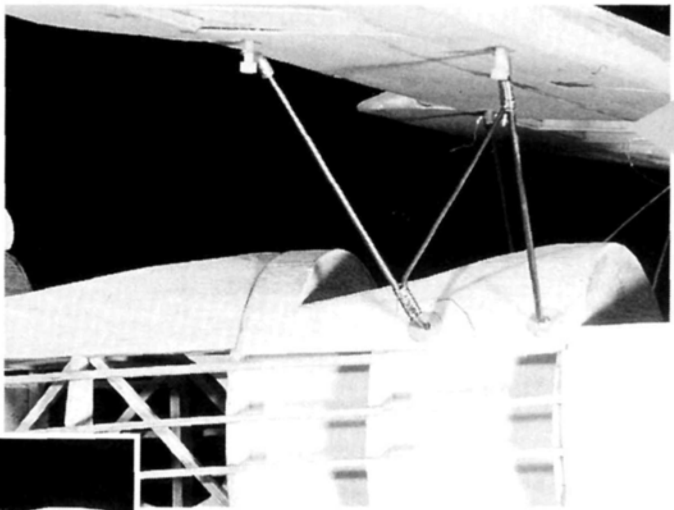
- Scrap Styrofoam blocks or cardboard boxes to jig up the airplane and the top wing.
- Ruler.
- Clamps.
- Carpenter's square or triangle.
- Robart* incidence meter.
- Coat-hanger wire to make "dummy" cabane struts.
- Wire bender and music wire for the struts.
- Soldering iron, silver solder and copper wrapping wire.



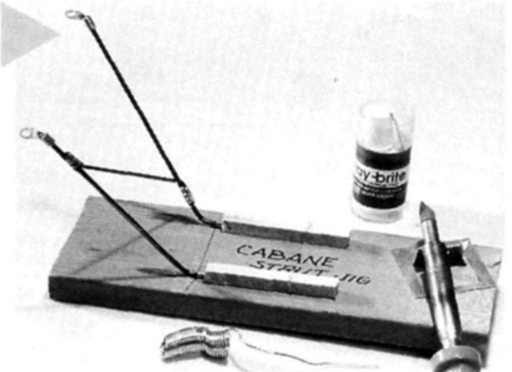
***3** With both front struts in place, support the trailing edge with a foam or balsa block. Now check again that the top and bottom wings are parallel. Using a carpenter's square or a triangle clamped to the model, adjust the fore and aft position of the top wing relative to a reference on the fuselage. The top wing can pivot on the front struts that are already in place. Now you are ready to set the top wing incidence. First, use your Robart incidence meter to measure the bottom wing incidence. Keep the top wing fixed in its fore and aft position. The clamped triangle shown prevents the wing from moving forward, and the foam block prevents it from moving aft. Clamp the incidence meter onto the top wing and shim up the trailing edge until you match the angle measured on the bottom wing. I've built and flown a number of biplanes, and I've had the best experience with equal top and bottom wing incidences. Some designs specify that the top wing have an incidence that's 1 degree greater than the bottom wing's. You can always achieve this refinement by shimming the top wing after assembly and/or flight tests.*



***4** You now have the top wing positioned correctly fore and aft, and the wings are parallel and have the same incidence angles. You're ready to measure for the aft cabane strut. Again, use a piece of coat-hanger wire as your pattern. Bend the music wire to match it, and install both rear struts without disturbing the top wing's position or angle.*



***5** With the wing still jigged in its correct position, use the coat-hanger wire to measure for the diagonal braces. Make these diagonal braces by bending music wire to match the coat-hanger wire. Without removing the struts from the airplane, carefully bind the diagonal brace to the forward and aft struts with copper wire.*



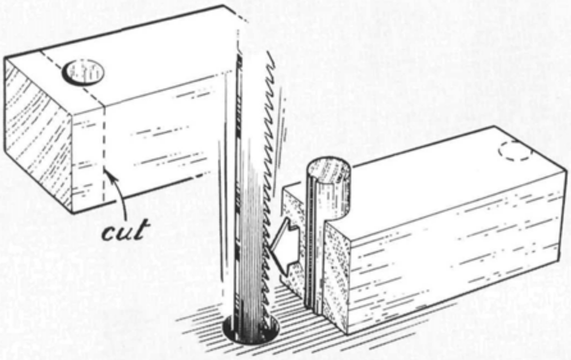
***6** Now solder the diagonal brace into position. It's possible to solder it into place on the airplane, but I don't recommend it—too much chance of burning your model. Carefully remove the cabane struts from your model without allowing them to move relative to the diagonal brace. Place the cabane strut assembly in a jig that duplicates the fuselage attachment, and solder the diagonal brace with silver solder. Reinstall the top wing and check its incidence again. Chances are, you'll be off by a degree or two. If you are, don't despair; this is typical. Fix it by shimming either the forward or aft cabane struts until the incidences of the top and bottom wings match. In the biplane shown, I used nylon washers to shim up the leading edge of the top wing until it was within 1 degree of the bottom wing's incidence. Flight tests proved this was entirely satisfactory.*

**Addresses are listed alphabetically in the Index of Manufacturers (for page number, see table of contents).* ■

HINTS & KINKS

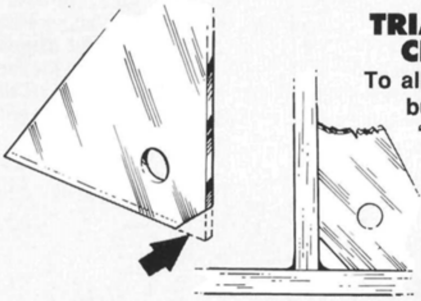
JIM NEWMAN

Model Airplane News will give a free one-year subscription (or one-year renewal if you already subscribe) for each idea used in "Hints & Kinks." Send a rough sketch to Jim Newman c/o Model Airplane News, 251 Danbury Rd., Wilton, CT 06897. BE SURE YOUR NAME AND ADDRESS ARE CLEARLY PRINTED ON EACH SKETCH, PHOTO AND NOTE YOU SUBMIT. Because of the number of ideas we receive, we can't acknowledge each one, nor can we return unused material.



GROOVED DOWELS

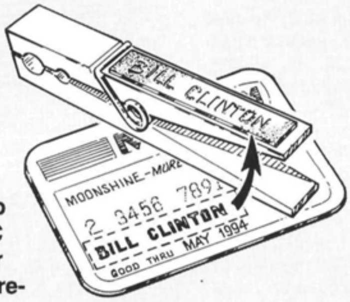
A very shallow groove sawn along a wing dowel will allow air and excess glue to leak out as the dowel is inserted—all the way—into a hole. While making the groove, hold the dowel in a pine block that has been prepared as shown in the drawing. The dowel will be held securely and may be pushed safely against a band-saw blade, with fingers well clear, to make a groove that's barely 1/64 inch deep. ***Bob Robert, Durrington, Wiltshire, England***



TRIANGLE CLEARANCE

To allow your triangle to butt closely against a "filleted" corner, trim off its corner, as shown. The fillet would otherwise prevent the triangle from fitting closely.

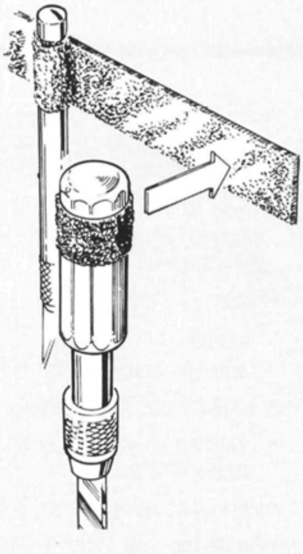
Michael Johnson, Adelaide, S. Australia



NEAT NAMEPLATES

If you trim your name off an expired charge card, you'll be able to glue it onto your R/C equipment (useful ID), or to a clothespin, for the frequency rack. A smear of PFM adhesive will securely attach plastic to wood, etc.

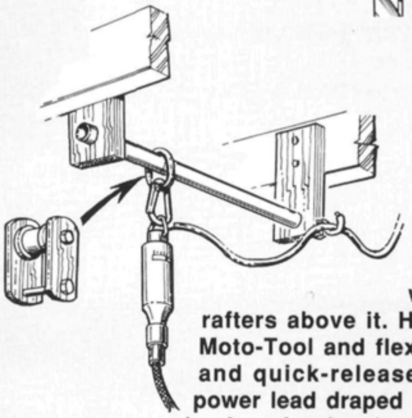
Gene Cartwright, Chippewa Falls, WI



HOLD-TIGHT TOOL RACK

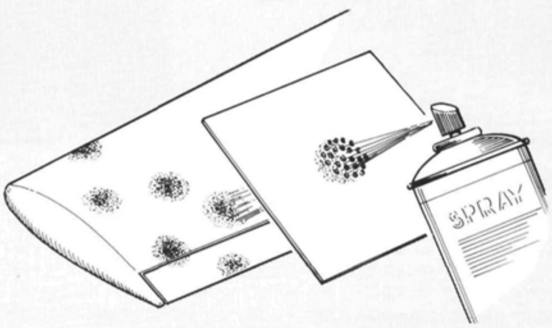
Stick one side of a strip of Velcro®-brand fastener around the handle of each of your tools and the matching part of the material to a shelf edge or another convenient place. Your tools will be held securely and conveniently nearby.

Paul Sorrels, Abilene, TX



SUSPENDED DREMEL

Secure a piece of conduit, the length of your workbench, to the rafters above it. Hang your Dremel Moto-Tool and flex drive on sliding and quick-release rings, with the power lead draped over an insulated hook and going (preferably) to a ceiling-mounted electrical outlet. You could replace the sliding ring with a simple pulley made with a bobbin, as shown. ***Richard Bates, Grand Island, NY***



MOTTLED CAMOUFLAGE

If you're aiming for a camo scheme, try this: punch holes close together in a stiff card, then spray paint through the holes and onto your plane. You'll have nicely controlled blotches with soft edges—perfect for camouflage. ***Levent Suberk, Bursa, Turkey***

Jet Hangar Hobbies

F9F-4/5 Panther

A Navy

WHILE I WAS looking for an aircraft kit to review, I ran across a bonanza of a deal. I found a ducted-fan kit that had great appeal, good scale accuracy and an economical price—Jet Hangar Hobbies'* F9F-4/5 Panther.

The Panther—the first of Grumman's "feline" series—made its first flight in July 1950. Panthers saw combat in the Korean War in a combination fighter/ground-attack role, when they were assigned to Navy and USMC squadrons. The Navy's Blue Angels flew them from 1950 to 1955. This aircraft may be best known for its roles in the movies, "Bridges at Toko-ri" and "The Fighting Lady."

by MONT CARTWRIGHT

THE KIT

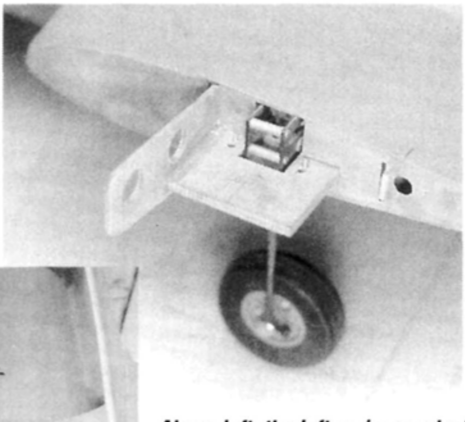
The airplane arrived in a securely packaged, sturdy carton. A single-piece fuselage; pre-seamed tip tanks; a three-piece, inlet-ducting system (split intake); and an exhaust liner are included. All the epoxy/glass parts are immaculate. The lines that have been molded into the fuselage show the cutouts for the hatch, the canopy, the landing gear, the body flaps, the dive brakes and the blow-in doors. The fuselage surface details, such as panel lines, are omitted because at 1/6 scale, the scale line definition would be too large to be accurate.

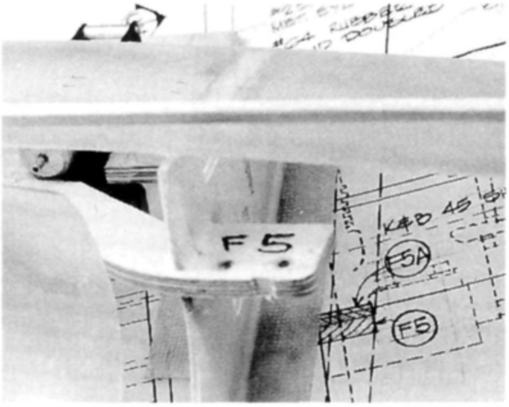
The wing and the horizontal stabilizer are accurately cut out of foam. The vertical stabilizer and the rudder are built up out of balsa, and a clear canopy is included. All wooden parts are precision hand-cut of high-quality balsa and lite-ply.

The plans consist of five, full-size, highly detailed drawings. The instruction booklet for the F9F-8 Cougar, whose construction sequence is nearly identical, is currently supplied; however, an instruction booklet for the Panther is forthcoming. The instructions are clear, concise, well-illustrated and follow a logical building sequence.

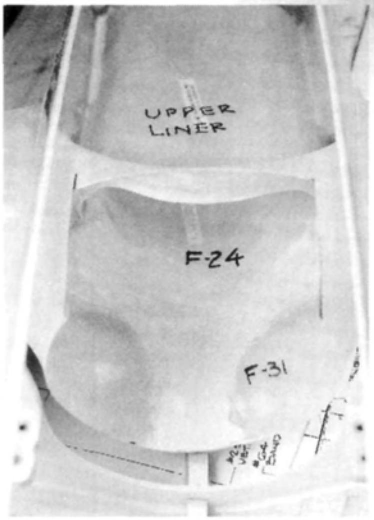
THE POWERPLANT

The Turbax* I fan unit and K&B* 9101 (7.5cc) engine with an Irwin* pipe are recommended. For added vertical performance, larger engines using the Turbax III or comparable 5-inch fan units can be used; however, with this arrangement, the tuned pipe will protrude approximately 6 to 8 inches from the exhaust outlet thereby destroying the scale side-view appearance. The new K&B 7.5cc engine using McCoy* racing plugs and K&B 500 fuel can turn the Turbax I fan unit at 23,800 to 24,3000rpm and propel a 10½-pound aircraft at approximately 120 to 130mph. This economical powerplant provides realistic, scale flight speeds with more than abundant power for most maneuvers.





Above left: the left main gear installation. At right: the Turbax I motor mount.



At left is the three-piece inlet liner system used in the Panther.

Favorite

LANDING GEAR

The gear are in a standard tricycle configuration. Rhom Air* gear (firewall-mounted/T-28-style nose) are recommended. Details for making scale struts are shown on the plans using Robart* Robo-struts no. 650.

FINISHING

A durable, scale-looking, low-weight finish can be obtained by covering all balsa surfaces with .6-ounce fiberglass cloth and polyester resin. This is followed by a coat of primer that's sanded before finishing with several thin coats of the final paint scheme. The scale techniques are left up to the individual builder, but all the details are shown on the plans. Unlike some other jet aircraft, there is a limited number of Panther versions to be modeled. Reference sources, such as Squadron/Signal Publication's* "F9F Panther/Cougar In Action" and Aero Publishers Inc.'s* "F9F Panther in Detail and Scale" can help.

CONSTRUCTION

Assembly progresses rapidly if you follow the instruction booklet and scale drawings. The builder must decide early on as to whether scale functions, i.e., retracts, body/wing flaps, speed brakes and leading-edge flaps (see the March '94 issue for my how-to article on leading-edge flaps), will be incorporated. I recommend adding them to enhance the model's scale authenticity and slow-flight characteristics. They may be omitted for sport modeling, however.

Construction can be expedited if the major components, i.e., the fuselage, the wings and the stabilizers, are built simultaneously and assembled later. Make the fuselage cutouts, and then install the formers, which are purposely slightly undersize to allow for a seam of glue (clever!). This technique avoids deforming the fuselage. Next, cut out the wing and the horizontal stabilizer, connect the linkages and complete the skin. Build up the vertical stabilizer

SPECIFICATIONS

Model name: F9F-4/5 Panther
Manufacturer: Jet Hangar Hobbies, Inc.
Type: ducted fan
Wingspan: 52 in.
Wing area: 550 sq. in.
Wing load: 28 oz. per sq. ft.
Airfoil: scale with scale washout
Weight: approx. 9 lb. dry
Length: 56 in.
No. of channels req'd: 5 to 7
Radio: Ace MicroPro 8000
Fan unit: Turbax I
Motor/engine size: K&B 9101 (7.5cc)
Wing construction: foam, balsa-skinned
Kit construction: fiberglass, foam, balsa and plywood
List price: $450 (includes shipping)

Features: include an epoxy/glass fuselage, inlet ducted, exhaust liner, wing tanks. Foam wings and horizontal stabilizer. A fiberglass engine cover cap is included with the Turbax I fan unit or available separately. The Panther has a built-up vertical stabilizer, a complete, precision, hand-cut wood kit including wing skins. No hardware is included. A highly detailed instruction booklet and five full-size detailed plans show all scale functions and details.

Hits
- Scale accuracy
- Quality of kit materials, durability
- Stable flight characteristics; ease of in-flight orientation
- Easy to build
- Economic powerplant with low noise level (100dB at 9.9 ft.)
- Detailed instructions and plans

Misses
- No hardware
- Some wooden parts need slight modifications to fit perfectly

FLIGHT PERFORMANCE

After having spent five months building the model and bench-testing the powerplant, I was anxious for the first flight. Recall that my Panther was fully dressed with wing and body flaps, leading-edge devices, dive brakes, retracts, cycling gear doors and eight servos. Nonetheless, because of the care I took to make the plane as light as possible (lightening holes in wood parts, debulking areas of non-structural foam, minimal use of expoxy), it weighed in at just less than 10 pounds fueled.

• Takeoff and landing

The plane taxied out to the runway. Full throttle was applied, the engine came on the pipe rapidly, and the aircraft rotated spontaneously in approximately 100 feet of runway. Depending on conditions, the Panther

can be expected to execute scale-like takeoffs in 100 to 150 feet. The aircraft required a little down trim but nothing more. The gear retracted, and off it went. The plane was rock stable and easy to track. Turns were graceful with no surprises. I set up a long approach in a dirty configuration (high-lift devices and landing gear deployed) and brought it in. Remember, you must carry a little extra power with wing and body flaps and gear deployed. A slightly nose-high attitude was attained, and I used the throttle to control the descent rate. The elevator was teased back to flare, and the Panther settled on the tarmac. Ground handling was no problem with the broad-based tricycle gear.

• High-speed performance

The K&B 7.5 (.45ci) ducted-fan engine and Turbax I are a good choice for this plane and easily propel the model into the 120 to 130mph speed range. Because the Panther is a "medium-size" ducted fan, slightly smaller than some other ducted-fan airplanes, it may appear to fly a little faster when it's first in the air.

• Low-speed performance

The Panther looked graceful and majestic as it traveled through the air. The flaps and the leading-edge devices were dropped to evaluate slow-flight characteristics. Deployment of leading-edge flaps and wing and body flaps permits approximately a 5 to 10mph speed reduction without loss of aileron control. Don't let the slow-speed flight fall under approximately 25mph, or you may experience a tip-stall. Again, no surprises. It had very positive slow-flight characteristics that cinched my feelings that the landing would be a walk in the park.

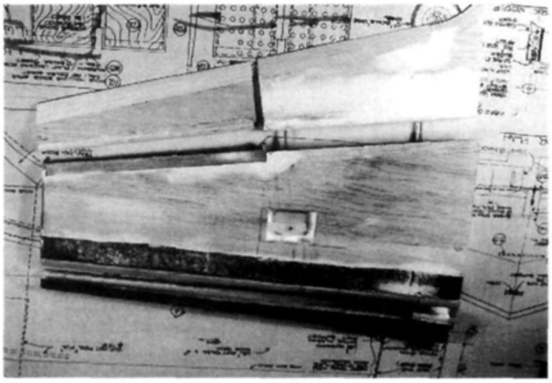
• Aerobatics

The Panther has no problem performing loops, rolls, split-S's, Immelmanns and similar maneuvers. It performs very axial rolls. Loops can be performed from level flight, but they're large and should be entered with speed. Inverted flight requires a little down-elevator.

A side view of the model reveals the classic Panther profile.

out of balsa and connect the linkages. Then install these parts on the fuselage. Now add the scale functions, the internal ducting and the powerplant. Before you apply the finish, make sure that the aircraft components function properly.

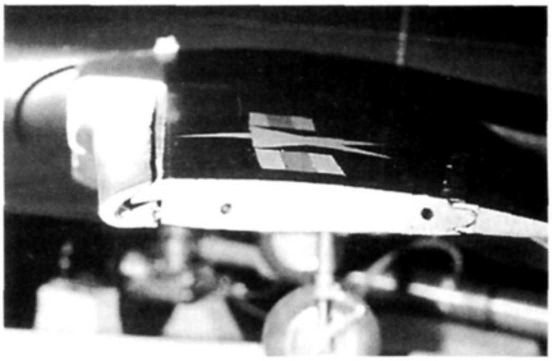
The basic structure of the model can be completed in two to three weeks. The amount of optional scale details may, of course, prolong construction.



Top view of the Panther wing under construction shows leading-edge flap components (this is not part of the standard kit).

RADIO

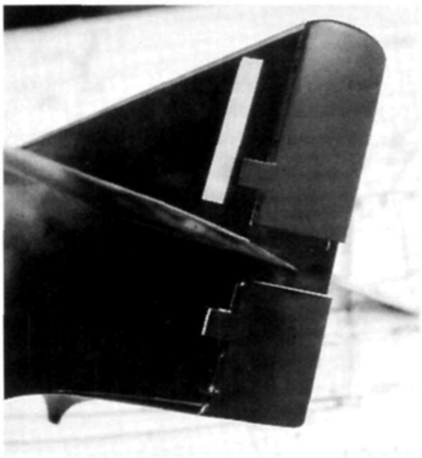
A 5-channel radio is needed for the basic functions, but if you add dive brakes, wing/body flaps and leading-edge flaps, you'll need seven channels. I chose the Ace* MicroPro 8000 system because of its versatility and reasonable cost. I used a combination of Futaba* coreless S9401, S9201 and micro-precision S133 servos.



End view of wing shows leading-edge flap mechanism profile.

CONCLUSION

Jet Hangar Hobbies has produced a high-quality, scale (even down to the scale wing washout), affordable, easy-to-build, ducted-fan kit. From start to finish, the project was pleasurable. The total price, including the powerplant and retracts, but excluding the radio, is less than $850, which is relatively affordable as ducted fans go. The Panther's flight characteristics and highly visible lines make it an excellent first ducted-fan model, yet it can entice the competitive-minded with its scale realism.



This closeup of the finished tail reveals that all the surface actuators are hidden internally.

I found that the staff at Jet Hangar Hobbies was always available to provide expert advice and product support. They genuinely want your project to be a success. Make your next jet the Jet Hangar Hobbies F9F-4/5 Panther.

**Addresses are listed alphabetically in the Index of Manufacturers (for page number, see table of contents).* ■

PART 1

Get the most out of your bipe by understanding its unique aerodynamics

Biplane Secrets

by CARL RISTEEN

Editor's note: this is the first in a two-part series on biplanes by Carl Risteen—an aeronautical engineer, model designer and unredeemed biplane junkie who has written before on such topics as flutter (see the March and April '93 issues) and servo-assist devices (September and October '93 issues). If you have an interest in bipes, this is required reading! In Carl's words: "Biplanes are challenging bundles of aerodynamic and structural characteristics, both helpful and hurtful. Understanding their unusual aerodynamics will enable you to enhance their strong points and diminish the weaker aspects of their unique personalities."

Trio of original bipes, with Doreen Armstrong

EVERYONE LIKES BIPES. Nothing else can transport you as readily to an era when flying was high adventure, replete with sensory delights of castor-scented wind and the music of singing bracing wires. Fire up your model bipe, advance the throttle as the little bird eagerly takes wing, and suddenly, at some level of consciousness, you are back in 1917, high over the trenches, Clerget rotary throbbing, twin Vickers at the ready, keeping an eye peeled for the Red Baron. (Even if some of your friends may regard your resemblance to Snoopy and his Sopwith Camel doghouse as a little nearer the mark.)

Ignoring a chorus of sniping at their aerodynamic shortcomings, the double-deckers remained the dominant aircraft species for several decades. Qualities other than peak aerodynamic efficiency kept them alive, even as first-line fighters, well into the 1930s. Bipes could be built lighter, stronger, tighter turning and, many thought, safer than monoplanes.

Antique engines were about as reliable as dollar watches and not terribly powerful for their weight. Forced landings, frequently on terrain that a suicidal buzzard would avoid, convinced early aviators of the wisdom of trading a little top speed for a lot of wing area, and light, sturdy construction.

BIRDS TO BIPLANES—AND BACK?

At the dawn of heavier-than-air flight, flying-machine mongers stole shamelessly from the only competition around—master aviators who had been in business for a long time. These feathered fliers used thin, under-cambered wing sections. Clearly, birds had to be on to something. The purloined airfoils efficiently lifted the slow-chugging, primeval aircraft those first few wonderful feet, and enthusiasm for flight soared.

Marvels of design, bird wings incorporate tricks that, after more than a century, continue to elude airplane designers, although they are slowly closing the gap. One very basic feature, wing warping for roll control, was adopted by the Wright brothers, and it played a starring role in their success. Ailerons—crude devices that no bird would be caught dead with—proved easier for airplanes to live with. Ninety years later, aviation is close to coming full circle, with wing warping receiving intense scrutiny for future fighters. Variable camber, compound slots, boundary layer control, variable wing sweep and lift-enhancing, unstable CG aft have already been appropriated from those clever birds.

Successful aviation pioneers shrewdly reduced the wing to its bare-bones essentials, adopting a more or less rigid structure. The thin wings did pose a problem. Stuffing enough structural beef into their meager internal confines to make them self-

The author's first R/C biplane design has an aspect ratio of 6. It sports a 64-inch wingspan and 1,375 square inches of wing area. It weighs less than 6 pounds with a Webra .61. With a wing loading of less than 10 ounces per square foot and loads of control surface, it's great at low-speed hot-dogging. It's a grizzled veteran of many fun-fly wars (recent photo).

Author Carl Risteen poses with an 84-inch-span, 12-pound, original bipe design. Tapered wings will be discussed in Part 2 (next issue).

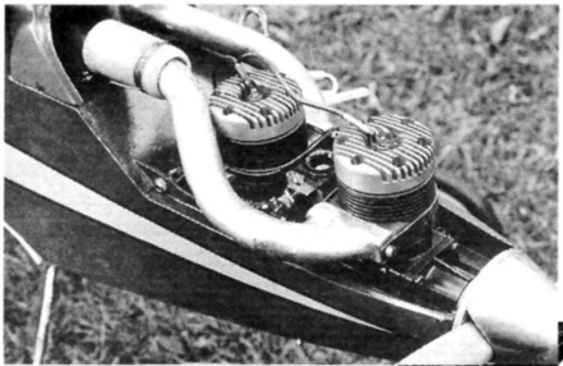
supporting would have imposed a crushing weight penalty, so early designers seized on a simple solution—wire bracing, which is tremendously strong for its weight.

For wire bracing, the biplane layout was a natural. The upper and lower wings formed the horizontal members of a deep and, thus, very strong, light and rigid bridge-like girder.

Some bold experimenters refused to run with the pack, and doggedly pursued the scent of higher efficiency that led down the monoplane trail. Monoplanes had long been suspected to be better aerodynamically, but they were trickier to brace with wires, and some paid dearly for their temerity.

As soon as aviators had cleared the roughest part of the debris-strewn path to flight, they licked their wounds and set out on a quest for higher speed. As speeds rose, fixed under-camber was found to cause a lot of drag, and was gradually reduced, but airfoils remained thin. (Having variable camber, birds had no need for thick airfoils.)

Then, some German experimenters hit on an epoch-making discovery: much thicker airfoils, unknown to birds, seemed to work well. Although



With the cowl removed, the modified HP 120 piped twin with custom headers can be seen.

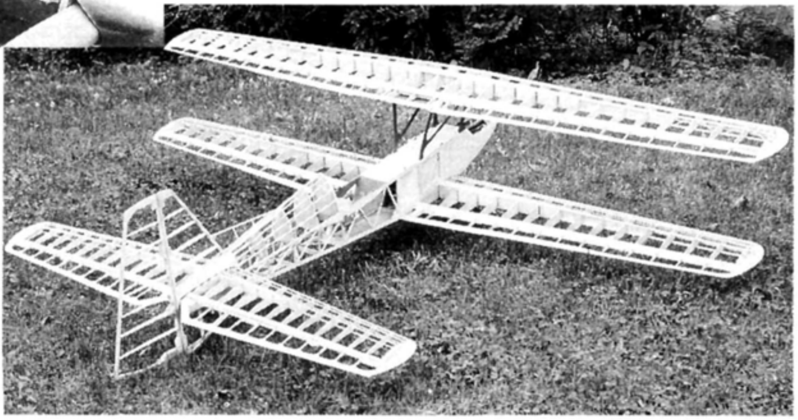
suffering from slightly higher drag and a more abrupt stall, the new airfoils held the seductive attraction of higher lift, and something else that would prove profoundly important: room for a much deeper structure—a structure that just might be strong enough to keep the wings together without all those draggy wires. Structural number crunchers knew that doubling the thickness of a wing could double its strength and quadruple its stiffness, for little increase in weight—a deal that was hard to resist.

First used by Junkers in 1910 and promoted by Fokker during WW I, the thick-wing idea slowly took hold, opening the door to the more efficient, un-braced monoplane.

WHY BIPLANE WINGS ARE LESS EFFICIENT

Any airplane wing that is developing lift has lower-pressure air above it and higher pressure underneath. Introduce a second wing above the first, and the high-pressure field under the upper wing tends to interfere with the low-pressure field above the lower wing. This turf dispute reduces the lift of both wings, but the lower wing

PHOTOS BY CARL RISTEEN



Above: powered by a piped HP 120 twin, this light (9½ pounds all up, without video gear), 84-inch-span sport bipe with video camera and video transmitter was pressed into service as a video mule. Despite the weight of the video gear, it has full aerobatics capabilities and unlimited vertical performance. The camera, video transmitter and battery add about 3 pounds.

Left: the bones of the 84-inch-span bipe show the lightweight construction used by the author on this light experiment.

This plane (aspect ratio of 10) is the experimental bipe mentioned in the article. Designed for a .20 to .40 2-stroke engine, it weighs less than 3 pounds and has 720 square inches of wing area and a wing loading of 9.5 ounces per square foot. With an HP .40, it loops fast and is very tight and efficient—great glide.

suffers more, because most of the lift is produced by the upper surface of a wing. This is a by-product of each wing being forced to fly in the other's downdraft, called downwash, in addition to its own downwash. Any wing must produce downwash to provide lift. The effect is similar to attempting to walk up a descending escalator. Energy that must be expended simply to stay at the same height rears its ugly head as drag.

Each wing, flying in its partner's downwash, needs a higher angle of attack than it would when flying solo. Drag increases considerably, particularly at higher lift coefficients, when the downwash hill is steeper.

When the two wings are working at low lift coefficients, such as at top speed, straight and level, downwash is minimal and the wings get along quite well. Drag is only a little higher (excluding the drag of those pesky wires) than that of a monoplane wing of the same total area. Yank the stick back for a tight turn requiring close to maximum lift, and the wing-versus-wing battle heats up. Drag may exceed 150 percent of that of a monoplane wing, for only 90 percent of the lift.

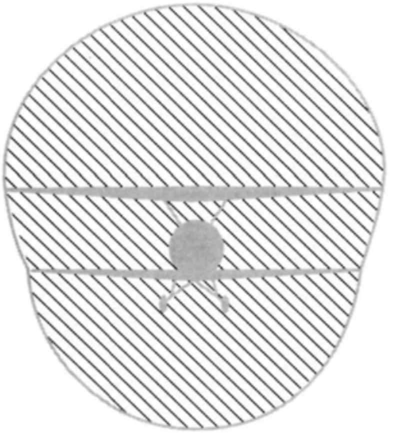
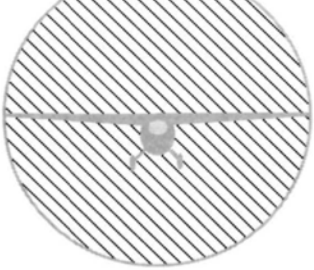


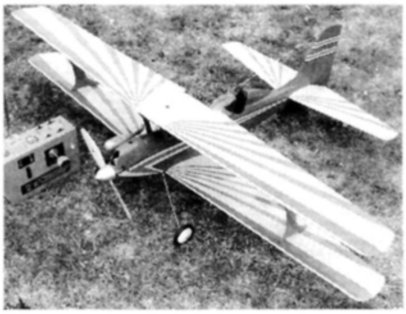
Figure 1. Front view of biplane and monoplane showing the area of the air stream assumed to be deflected by the wing in producing lift (used in calculating monoplane equivalent of biplane aspect ratio).



PUTTING NUMBERS ON THE PROBLEM—INDUCED DRAG

The high-drag disease also afflicts monoplane wings of rather low aspect ratio, leading early designers to correctly conclude that biplane mutual wing interference had the same effect as reducing aspect ratio. Aspect ratio (the ratio of the length, or span, of a wing to its width, or chord) is extremely important to wing efficiency, i.e., carrying the load with minimum drag. In wings of low aspect ratio, more of the high-pressure air short-circuits around the wingtips and joins the low-pressure air above. The short-circuiting reduces lift and wastes a lot of energy in generating wingtip vortices—little tornadoes that trail a long distance behind the wings. The result is lift-induced drag, shortened to "induced drag." These energetic little whirlwinds often reveal their presence while we are performing consecutive loops, when the model suddenly spasms into a bank on overtaking a vortex.

Wings exert an influence on the air stream, and vice versa, that extends to a considerable distance—in theory, all the way to infinity (or the limits of the atmosphere). Wings need plenty of elbow room to do their job at top efficiency. However, when powered flight was in its "teen years," theory people determined that only a negligible portion of a wing's vertical field of influence extends outside a circle centered at mid-span and touching each tip (see Figure 1). The shaded area bounded by the circle shown in the illustration is called "sweep area." Introduce a second wing spaced vertically close enough above the first to make their territorial boundaries overlap, and performance suffers. The increase in induced drag was found to be a function of sweep area lost to overlap. This loss is caused by mutual interference when two wings are spaced vertically closer than one wingspan to each other, as shown in the head-on view of a biplane in Figure 1.



With a wing aspect ratio of 8, this biplane is a "little demon, but very forgiving in terms of low-speed handling." It was designed for a .20 to .40 engine, and it's a blast to fly with an HP .40 and a Webra .32. Weighing 2¾ pounds, it has a 48-inch wingspan and 575 square inches of wing area.

Biplane mutual-wing interference has the same effect as lowering the aspect ratio of a monoplane wing. A biplane wing with a fairly respectable aspect ratio of 6 may perform similarly to a monoplane wing with an aspect ratio of less than 4. Induced drag increases in inverse proportion to aspect ratio. Halving the aspect ratio doubles induced drag. At maximum lift, the induced drag generated by a rather low-aspect-ratio wing may exceed 90 percent of the drag of the entire airplane. This takes a lot of engine power to overcome and greatly steepens the glide.

CHOOSING THE RIGHT GAP

Increasing the vertical separation (gap) between the wings reduces drag and slightly increases lift. Unfortunately, a large gap dictates the use of longer and, thus, heavier and "draggier" cabane and interplane struts to support the wings. As always, there is no free lunch. A large gap may also hurt handling. The usual path toward increasing the gap, i.e., raising the upper wing, may also raise the center of drag too far above the center of gravity and the thrust line and thus degrade aerobatic line-holding accuracy. Figure 2 shows the effect on lift and drag of varying the gap-to-chord ratio for a biplane with an aspect ratio of 6.

Most designers settle on a gap-to-chord ratio of somewhere between 1 and 1.5. Increasing the gap from 1 to 1.5 times the chord

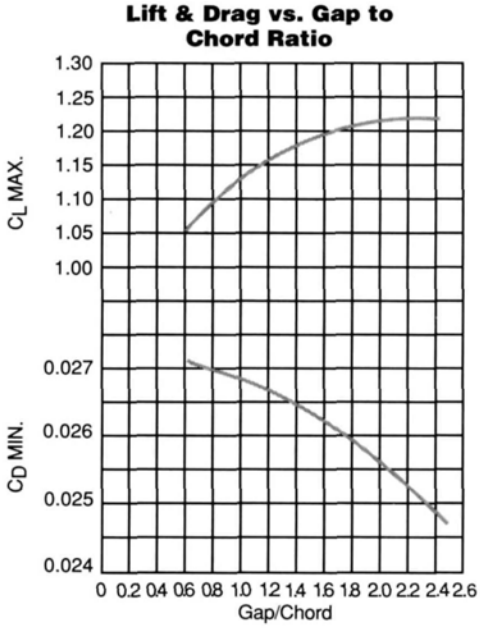


Figure 2. Variation of biplane wing lift and drag with gap-to-chord ratio, for aspect ratio of 6, at a low Reynolds number. This chart assumes an aspect ratio of 6. If you prefer to think in terms of a gap/span ratio, simply divide the gap/chord numbers by 6.

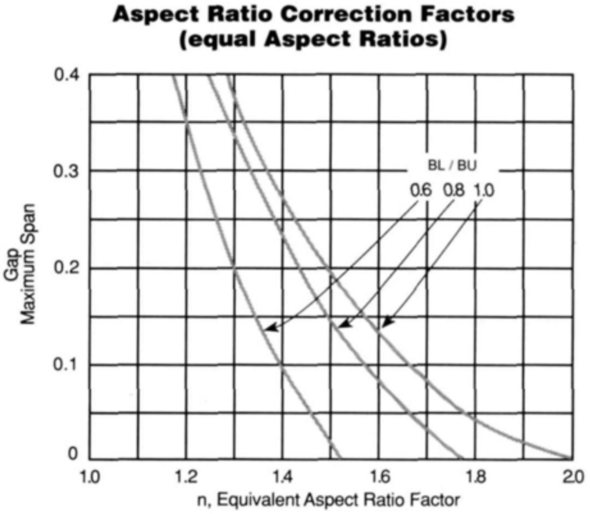


Figure 3. This chart provides the correction factor (for induced drag) for finding the equivalent monoplane aspect ratio. It is assumed that the aspect ratios of both biplane wings are the same. The line labeled 0.6 represents a lower wing that is .6 the span of the upper wing. The line labeled 0.8 represents the case where the lower wing is .8 the span of the upper wing. 1.0 indicates both wings are of equal span. (bl = lower biplane wing; bu = upper biplane wing).

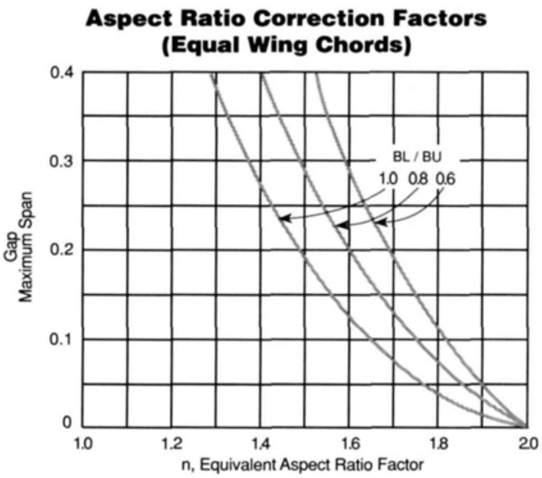


Figure 4. Aspect-ratio correction factors (for induced drag) for biplanes with equal upper and lower wing chords. (bl = lower biplane wing; bu = upper biplane wing). This chart is read like Figure 3, but is for biplane wings where the relative spans of the upper and lower wings vary, and wing chords are the same.

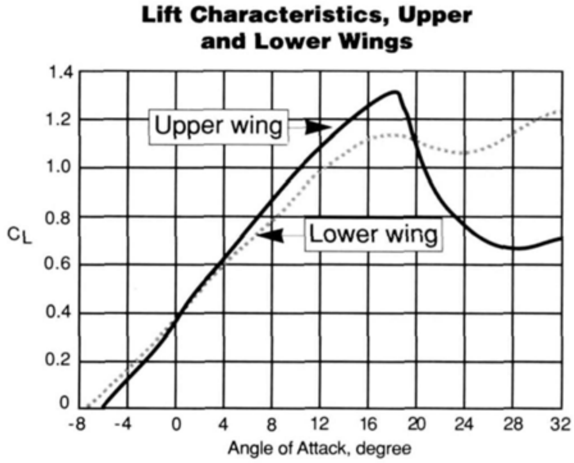


Figure 5. Lift characteristics for the upper and lower wings of an un-staggered (orthogonal) biplane. Stagger will accentuate the difference between the lift of the upper and lower wings. Note that the lower wing continues to produce nearly maximum lift long after the upper wing has stalled. This gives the combination a gentle stall.

will typically reduce induced drag by about 8.5 percent and increase lift by 5 percent. Going all the way to a highly uncommon ratio of 2 reduces drag by a further 4.7 percent and increases lift another 2.5 percent. Returns diminish rapidly for a gap greater than about one chord.

GAP A PROBLEM? TRY A HIGHER ASPECT RATIO

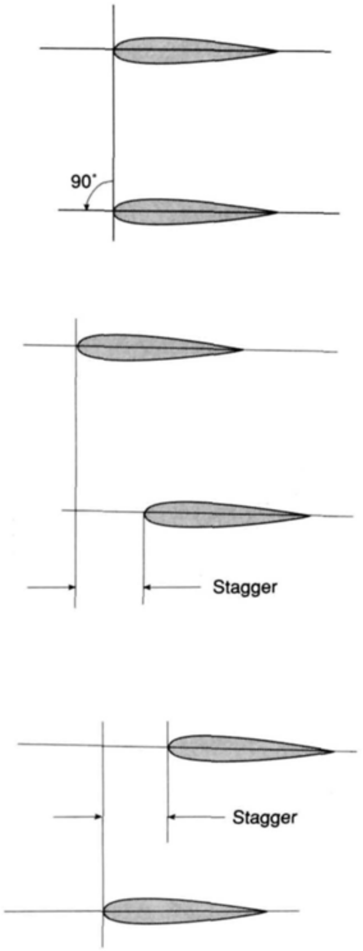
Bipes tend to have higher parasite and induced drag than monoplanes, and that makes them more power hungry. Bipes also present the opportunity to provide a lot of lifting wing area within a compact envelope, enhancing the lift-to-drag ratio and reducing the need for brute power. Clipping the wings of a typical sport bipe in an attempt to squeeze out a little more speed is the wrong way to go; it usually results in a nasty little beast that literally falls out of the sky when you cut the power.

Following a brief fling with stubbier wings in an aerobatic biplane design that suffered a lot of induced drag, I bit the bullet and went to an uncommonly high aspect ratio, at least in bipe models, of about 8, with a gap of about 1.2 times the chord (see the photo of the 68-inch-span bipe). This gave me a gap-to-span ratio of 0.14, and with wings of equal span and area, the aspect-ratio correction factor, as shown in Figure 3, was about 1.57. Dividing the biplane aspect ratio of 8 by the monoplane aspect ratio correction factor of 1.57 gives an equivalent monoplane aspect ratio of 5.1, which is typical of many fine performing aerobatic monoplanes. Overall performance was much improved. Careful wing structural design minimized the weight penalty inherent in a higher aspect ratio to about 3 percent of total weight. A later experiment took the aspect ratio to 10, with still better results (see photo).

Let's look at a biplane with a more common aspect ratio of 6. If we give it the same gap and wing area as the bipe just examined, the gap-to-span ratio becomes 0.162 and, looking at Figure 3, the aspect-ratio conversion factor will be about 1.54. To get the equivalent monoplane aspect ratio, divide 6 by 1.54, which yields about 3.9. A low effective aspect ratio of 3.9 (comparing it with the effective aspect ratio of 5.1 of the biplane just previously discussed) will result in about 1.31 times as much induced drag at the same lift coefficient and about 5 percent less maximum lift (5.1/3.9 = 1.31). The result will be a lot more loss of speed in tight maneuvers, a slight increase in minimum turning radius and a much more brick-like glide.

LOW WING LOADING AND CLEAN DESIGN

If you have a biplane design with a low effective aspect ratio, do not despair. Using a lower wing loading and a cleaner design can, to a



Un-staggered (orthogonal) biplane wing arrangement
Very acceptable layout, aerodynamically and structurally. Center of lift at about 22% of mean chord (compared with about 25% for a monoplane)

Positively staggered wing arrangement
Slightly gentler stall, and very slightly lower drag than un-staggered arrangement. Center of lift is slightly farther forward.

Negatively staggered wing arrangement
Slightly sharper stall than un-staggered arrangement; very slightly lower drag. Much less common than positive stagger; used more commonly on cabin biplanes with upper wing attached directly to the fuselage top, without cabane. Center of lift slightly farther back.

Figure 6

considerable degree, offset the bad effects of a low aspect ratio. With a lower wing loading, you don't need to work the wings as hard to get tight turns. As they say, there's more than one way to skin a cat. Reducing weight by 10 percent while keeping wing area the same will reduce induced drag to 0.90^2 (because the induced drag varies as the square of the coefficient of lift), or about 81 percent that of the heavier airplane at the same turning radius. Similarly, reducing weight by 20 percent will reduce induced drag to only 64 percent of its pre-diet magnitude. Reducing wing loading by increasing wing area without reducing weight will also help, although the model will be slower.

Reducing parasite drag will help the model fly faster and produce the lift needed for clean maneuvers—without needing to resort to drag-producing high lift coefficients. Clearly, low wing loading, weight and drag are very important if you want an outstanding bipe that is more forgiving and a pleasure to fly.

WING STAGGER—HELPFUL OR JUST PRETTY?

"Stagger" means placing one of the wings, usually the upper, ahead of the other. Stagger offers little aerodynamic benefit, at least in terms of lift and drag. Its chief benefits are that it increases the pilot's upward field of vision and makes access to the cockpit easier by moving the upper wing out of the way.

A little sweepback and cutting away of the center of the upper wing's trailing edge are also frequently used for the same reasons. A large cutout in the upper wing of half the chord or more has a very bad aerodynamic effect; it greatly increases induced drag, even if a reasonably decent airfoil section is preserved.

Stagger is called positive when the upper wing is ahead and negative when the lower wing leads the parade, such as on the Beechcraft 17 Staggerwing. Positive stagger gives the upper wing more of the lift and the lower wing more of the drag at higher lift coefficients. The net effect is just a very slight improvement, and it has little effect at low lift coefficients. It does delay the stall of the lower wing to a higher angle of attack, giving the combination a slightly softer, more gradual stall—a good thing. It also lowers sink rate a little in spins, particularly of the flat variety. The effect of negative stagger is the opposite of positive stagger, except that aerodynamic efficiency is very slightly higher. Fifty percent positive stagger will increase maximum lift by about 5 percent.

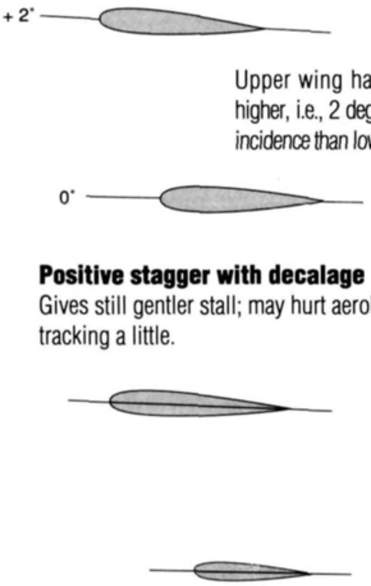
Without stagger, the lower wing develops less lift than the upper wing at high lift coefficients. Beyond stall, the lower wing develops considerably more lift than the upper (see Figure 5). Positive stagger accentuates this characteristic. Downwash from the upper wing seems to help keep the airflow attached to the upper surface of the lower wing, delaying its stall to an extremely high angle of attack of 30 degrees or more and keeping it flying—and its ailerons in business—long after the upper wing has stalled.

Stagger is usually measured by the percentage of the chord by which one wing is ahead. Fifty percent positive stagger means that the upper wing is ahead of the lower by 50 percent of its chord, or in the case of unequal upper and lower wing chords, the mean chord.

By giving the upper wing more of the lift, positive stagger also moves the center of lift ahead: from the normal 22 percent (for un-staggered biplanes) mean chord position to about 17 to 18 percent of the mean chord in the case of 50 percent stagger. This requires that the center of gravity be moved ahead by a roughly equal distance.

Positive stagger reduces the angle of attack for zero lift just a little, and it may require just a touch of positive stabilizer incidence, say ½ degree, to compensate.

In inverted flight, positive stagger becomes negative. Most of my own bipe designs use 45 to 50 percent positive stagger, and the handling difference, upright versus inverted, seems relatively minor. Inverted snap-roll entry seems a little cleaner, but the rotation rate is higher and requires quicker reflexes.



Upper wing has slightly higher, i.e., 2 degrees more, incidence than lower wing.

Positive stagger with decalage
Gives still gentler stall; may hurt aerobatics tracking a little.

Unequal chord upper and lower wings
(Usually with shorter span on smaller lower wing; reduced drag; aerodynamically closer to a monoplane.)

Figure 7

DECALAGE—WORTHWHILE OR A RIGGING NUISANCE?

Decalage is the difference between a bipe's two wings' angles of incidence—the angle at which the wings are placed in relation to the fuselage (see Figure 7). Positive decalage

(Continued on page 87)

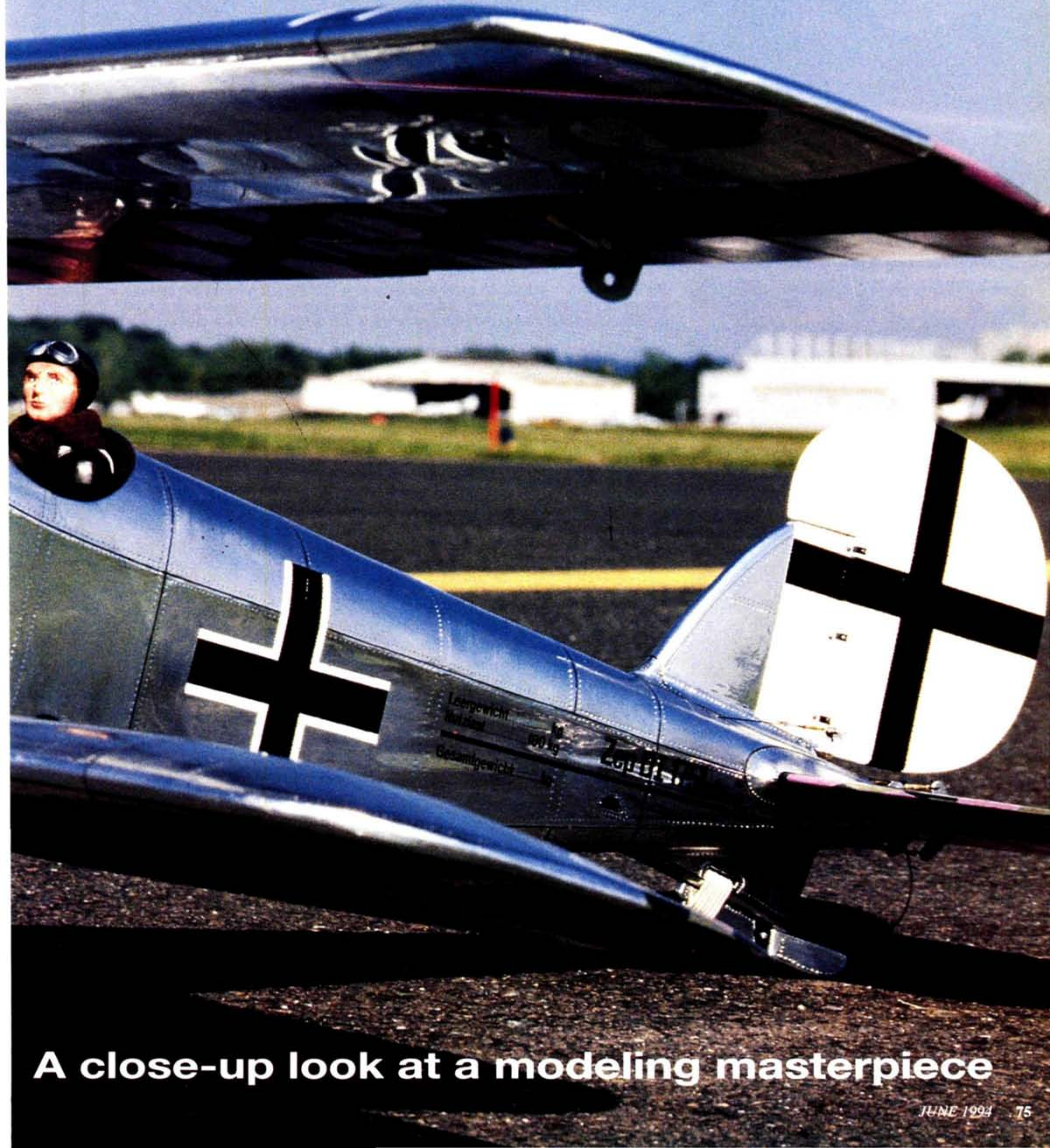
The Dornier Zeppelin

by STEVEN STRATT

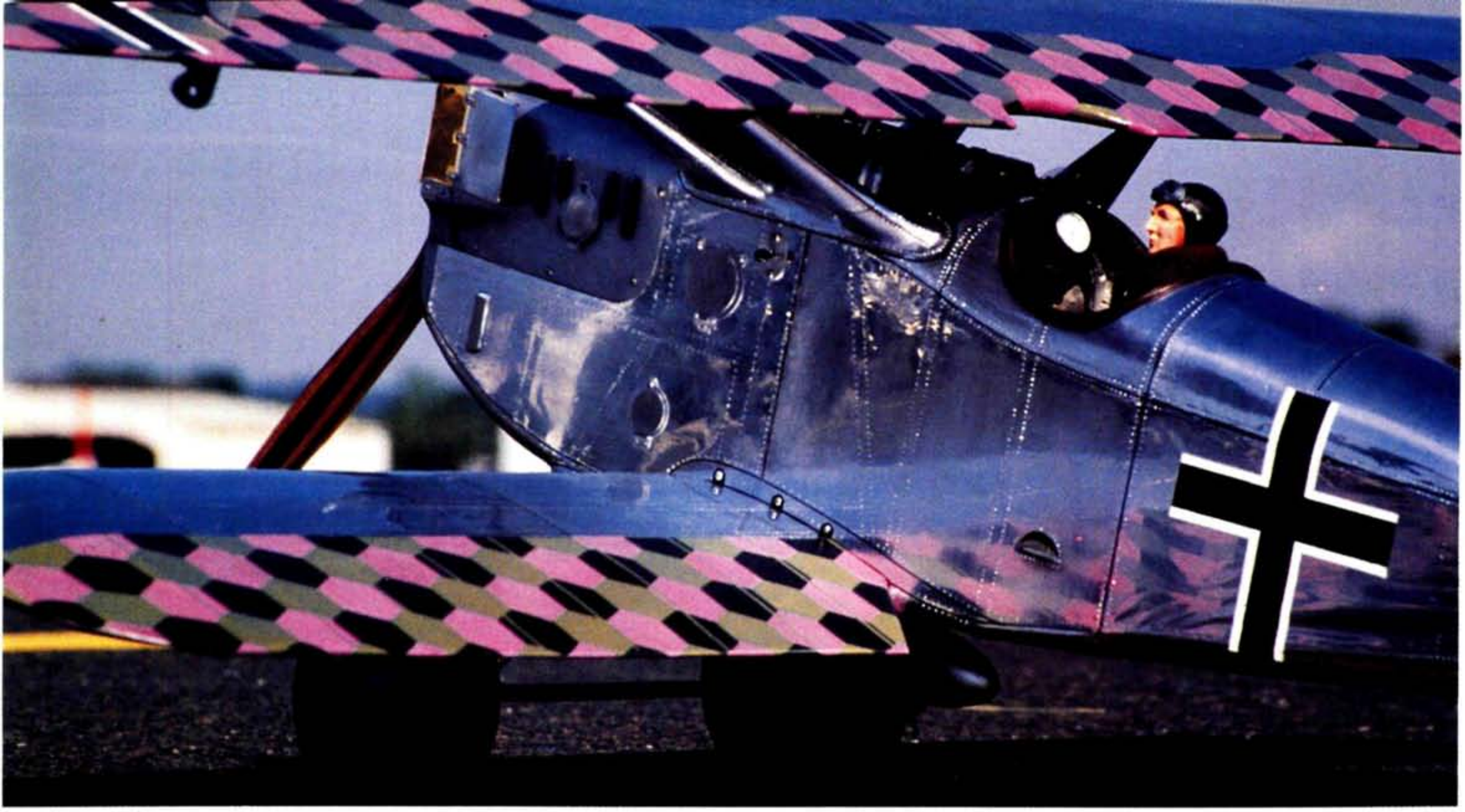
PHOTOS BY STEVEN STRATT & WALTER SIDAS

D.I Part 1

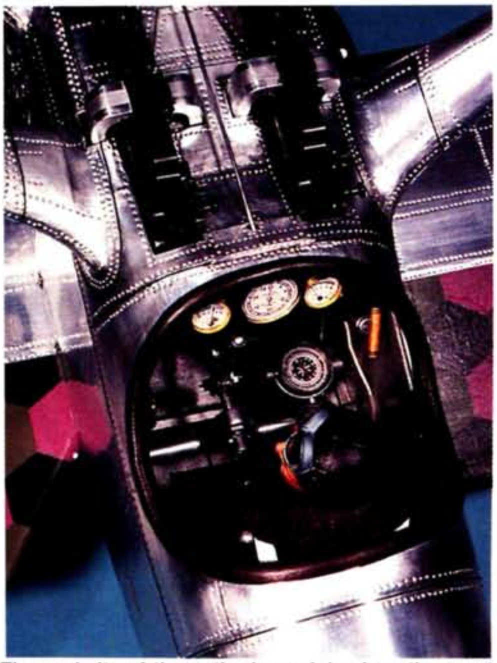
Editor's note: Steven Stratt, owner of Airdrome Models, has a well-earned reputation for producing beautiful, electric-powered scale models and matching, elegantly annotated, building plans. In this article, which concludes next issue, Steve describes his 2-inch-scale Dornier Zeppelin. This model not only took first in Scale at last year's KRC Electric Fly, but it was also quite an impressive flier. If you have an interest in scale modeling, you'll appreciate the fine craftsmanship that went into this unusual airplane.



A close-up look at a modeling masterpiece



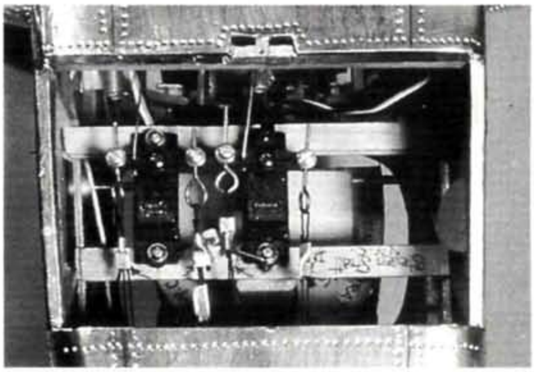
The trailing edges of both the upper and lower wing and the tail surfaces are covered with Solartex iron-on fabric and hand painted to duplicate the three-color, German, hexagonal, camouflage pattern. An added feature popular with spectators is that the pilot's head moves with rudder control.



The cockpits of the author's models show the great attention to detail that is his trademark. The rudder bar and the joystick on the D.I are articulated and move in response to control-surface movement.

WHAT SCALE buff wouldn't choose large, scale-like props over the tiny, toothpick, glow-engine types? Clean, quiet, vibrationless power means dramatically lighter airframes and the ability to carry more authentic-looking scale details.

As an industrial designer, I've always had a deep respect for the prototypes that were designed during the early years of aviation. These airplanes have been a favorite subject of mine in my scale-modeling endeavors. Since starting the Airdrome Plans Service* in the early '70s, I have become convinced that electric power is well-suited to scale R/C models. Even the heavy batteries required for scale electric planes turned out to be a plus as they created ballast for the short-nose, tail-heavy WW I and "golden age"



With the removal of a belly hatch below the cockpit, access to the servos is painless. Notice the simple, yet functional, cable-to-servo attachment.

aircraft that I'm so fond of!

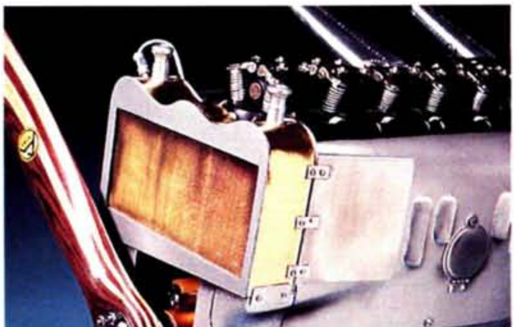
This is the story behind my Dornier D.I, which won first place in Scale at the last KRC Electric Fly (see the January '94 *Model Airplane News*).

WHY A D.I?

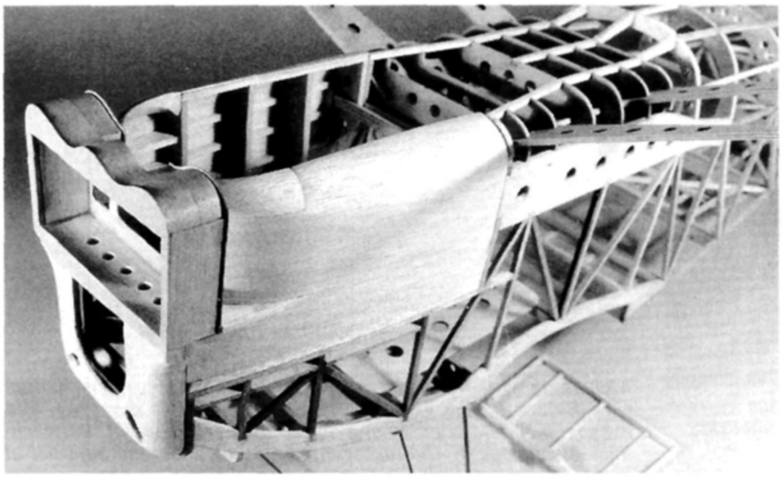
My criteria for selecting subjects for the Airdrome were twofold. First, I wanted a prototype of historic significance. Second, the aircraft's configuration had to be suitable for scale, electric R/C modeling.

The D.I meets my first criterion as the most structurally advanced

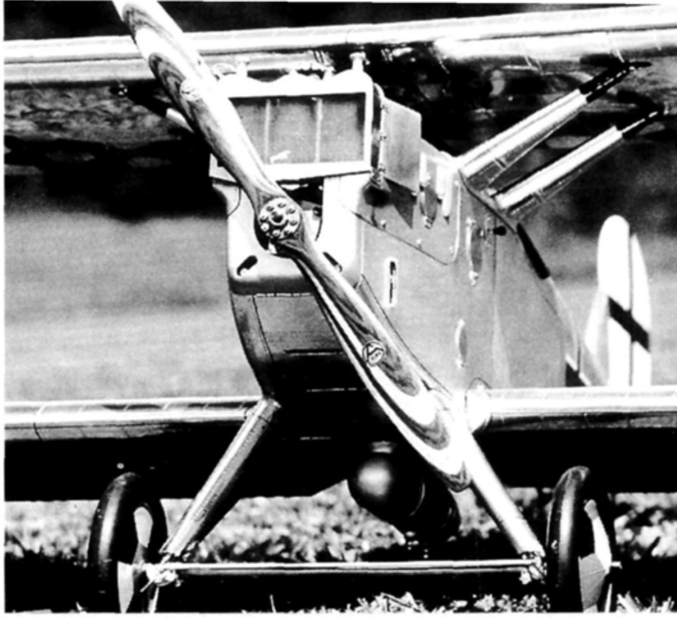
With the top wing removed from its cabane struts, you can clearly see the detailing of the dummy engine and machine guns. Notice the servo lead that snakes out of the front left cabane.



You just don't see detail like this on models every day. The author is a master of scale art, and his models are a feast for the eyes.



All the pieces fit together nicely. Notice the liberal use of lightening holes to minimize weight.



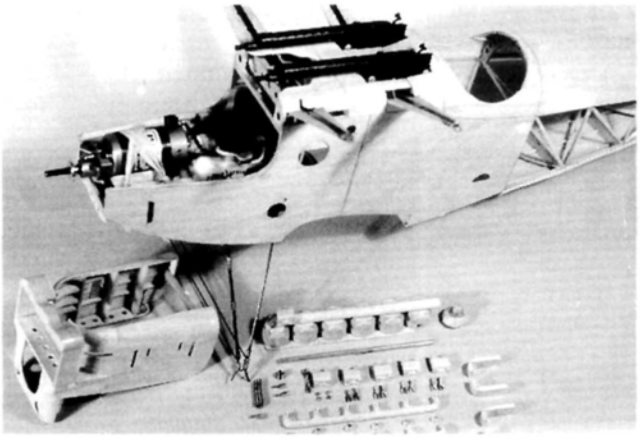
plane of its time. (Owing to its late arrival in 1918, it was never put into active service.) It easily satisfied the second criterion with its clean, low-drag, aerodynamic design made most obvious by the absence of the usual WW I plethora of interplane struts and rigging wires. Drag reduction was further enhanced by careful airfoil shaping of the massive cabane struts and landing gear. Its car-type brass radiator is perfect for motor/battery cooling, and the boxy fuselage and thick wings are ideal for a light, strong, classic, balsa structure.

My Airdrome plans for the D.I reveal structures that are reminiscent of the large, rubber-powered models of yesteryear, with some contemporary electric power and R/C components thrown in. Despite the detailed appearance of my plans, average building skills should suffice. Builders can be as detailed as their skill and patience permit and still achieve unusually satisfying scale-like static and flying results.

To do justice to the splendid D.I photos generously given to me by Peter M. Grosz, I have attempted a mini summary of this remarkable plane (see sidebar).

SPECIFICATIONS

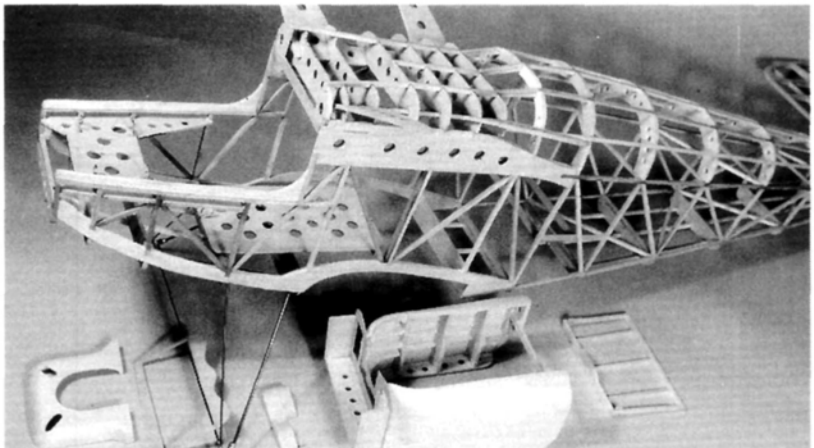
Type: WW I advanced German fighter
Scale: $\frac{1}{6}$ scale (2 inches to the foot)
Wingspan: 56 inches
Wing area: 980 square inches
Total weight, ready to fly: 7.68 pounds (123 ounces)
Airframe weight: 4.15 pounds
System weight: 3.53 pounds
Wing loading: 18 ounces per square foot
No./type of cells: 18, 1500mAh SR* Max
Rec. battery: 250mAh
Speed controller: Astro Speed* 207
Radio used: 4-channel Futaba* with (three) S-133 servos
Prop: Master Airscrew* wood (12x9) used with 30A fuse
Flight time: 4 to 6 minutes
Control throws: rudder—30 degrees (both sides); elevator—20 degrees up and down; ailerons—20 degrees up, 15 degrees down



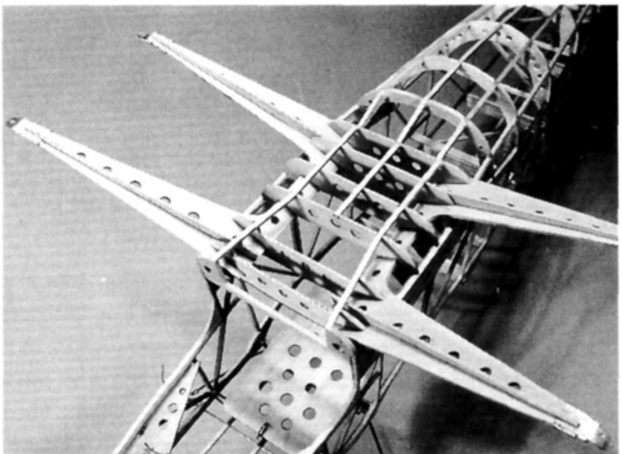
Note the gun-attachment openings and the BMW dummy balsa parts. To carry the flight and landing stresses, the model uses $\frac{1}{32}$-inch ply sheet from the cockpit forward.

LEARNING BY DOING

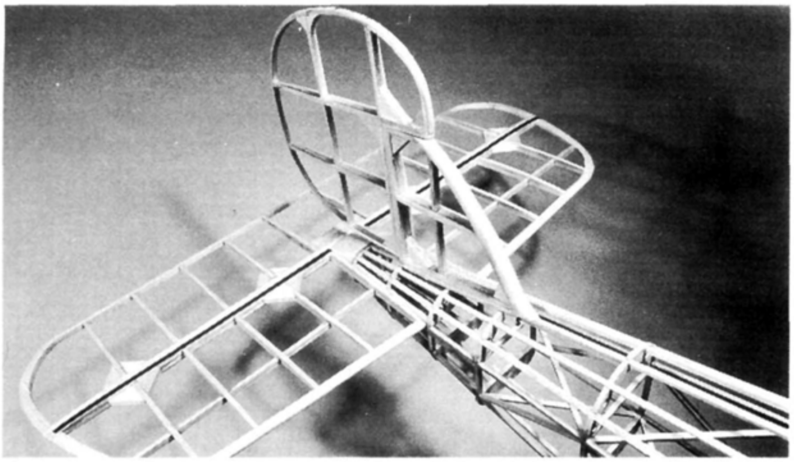
The latest revisions to my 2-inch-scale D.1 are due in part to what I learned from my



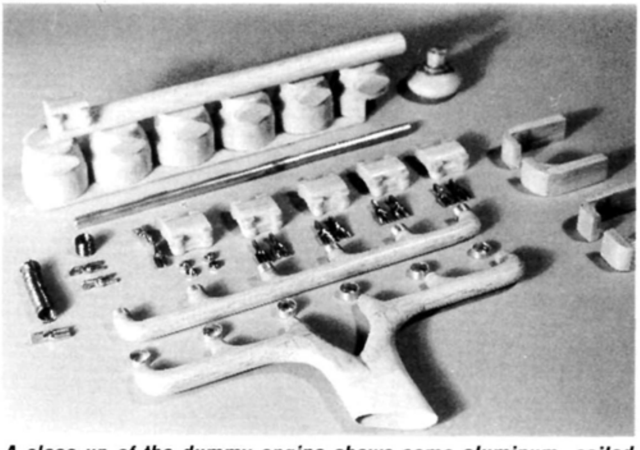
The basic fuselage structure is made of $\frac{1}{8}$-inch-square, medium-balsa strips and $\frac{1}{8}$-inch hard-balsa sheet. New cabanes and the motor-mount base are $\frac{3}{32}$-inch ply.



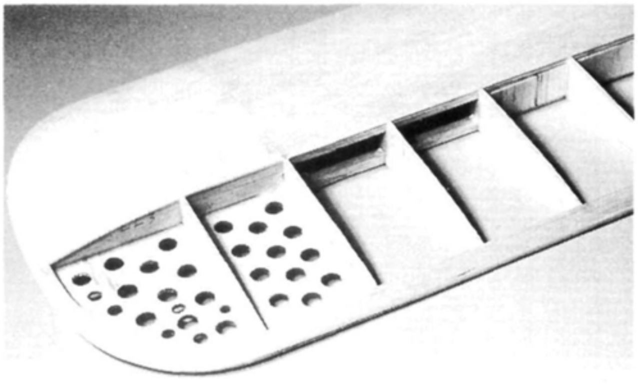
The first cabane ply version had each strut "ribbed" with a $\frac{3}{32}$-inch ply strip, later changed to .007 carbon fiber. The perforated motor-mount base and battery mount are also $\frac{3}{32}$-inch ply.



The open-framed tail is built flat with 3/16-inch-thick balsa and by adding 3/16-inch sheet riblets. Notice the carbon-fiber strip on the trailing edge of the horizontal stab.



A close-up of the dummy engine shows some aluminum, coiled wire springs for the exposed, overhead, camshaft assembly. The exhaust manifold is made of balsa with an exit made of .007-inch-thick plastic sheet. The rocker arms are cut, filed and bent out of brass yoke-shaped electrical brass connectors. The gun cartridge case and ammo chutes are on the right.



The lower wing uses 1/32-inch-thick sheeting. The tips are built up out of 3/16-inch-thick medium balsa. Notice the 1/16-inch-thick shear webs between the main spars. The trailing edge is sheeted top and bottom with 1/16-inch-thick balsa, and the ribs are 3/32-inch-thick balsa.

participation in the 1992 KRC competition. Flying buddy Dave Baron flew my scale Sopwith Swallow to first in Scale using a Astro* 25 Cobalt geared system. Like its full-size counterpart, the Swallow required a speed-gaining dive before aerobatic entry. Its realistically slow, scale-like speed appeared dull, however, compared with some of the other, faster scale electrics.

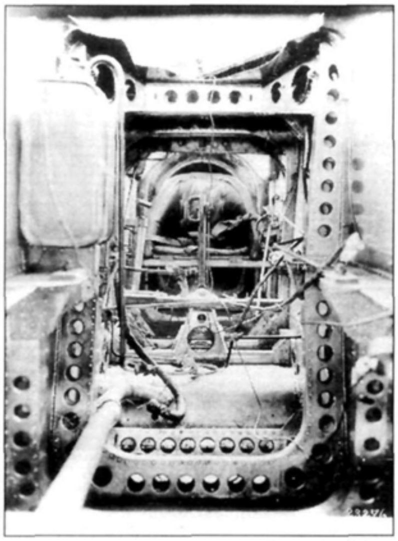
Accordingly, I upped the Swallow's power to an Astro 40 system, and we were quite pleased to be able to stunt-fly from straight and level flight without compromising the Swallow's scale, sedate pace at three-quarter throttle. The D.I, of course, also received the Astro 40 system, but it's much more aerobatic because of its cleaner aerodynamics.

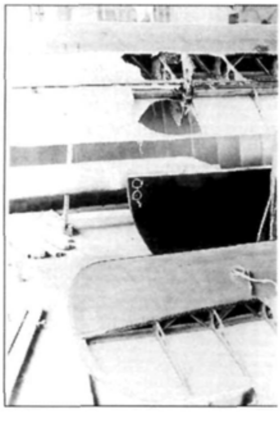
Dave's skillful piloting at KRC convincingly showed the 40's reserve power in steady, authoritative touch-and-go's, looping, rolling, some four-point rolls,

D.I Design History

This is the U.S. Army A.S. 68546 D.I in 1921 at McCook Field, Dayton, OH. Its project number—P241—is in black on the rudder, and it was probably D1754/18 with the BMW engine. The exhaust pipe and prop are shaped differently from the German prototypes. The fabric areas are plain, white, doped linen, so this version is much easier to model.

This view from the nose looking aft shows the riveted, perforated dural bulkheads (formers) around which the dural skin forms the fuselage without stringers or longerons, in monocoque form. The stick, rudder bar, magneto, oil tank, lower wing's leading edge (under the tube-mounted controls), and the pilot's padded, adjustable seat are clearly visible.

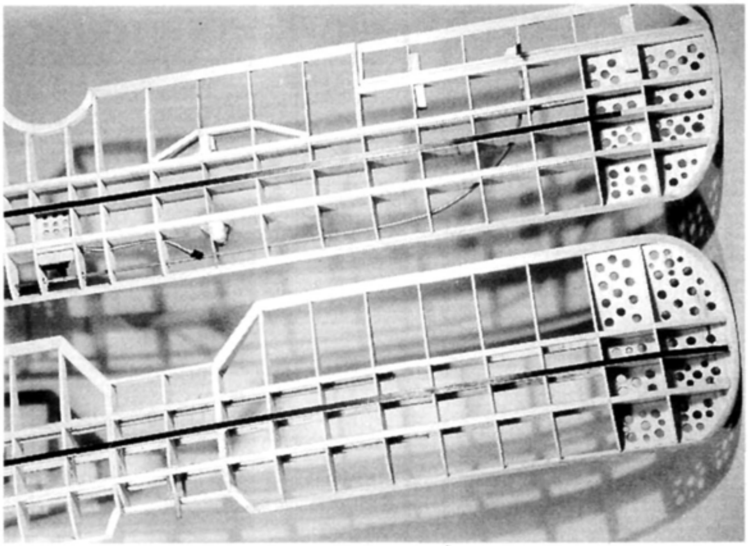




The design of the D.I began in Germany in February 1918 under the supervision of Claude Dornier. Adolf Rohrbach, an assistant engineer, is believed to have been the first to use the now classic, Duraluminum (dural) sheet, stressed skin and dural torsion-box structure in the wings. For the first time, the skin bore the primary load. In contrast, the so-called "Platz" Fokker D.VIII wooden wing and the Junker metal cantilever wing both relied primarily on their internal frameworks for major load bearing.

Nor is the familiar Junkers corrugated skin true stressed-skin construction.

(It serves, instead, as



Basic wings use one 1/4-inch-wide strip of .007-inch carbon fiber on the top and bottom of only the middle spar. Spars are 1/4x3/16-inch medium balsa with mostly 3/32-inch ribs. The cabane "attach" ribs are 1/16-inch ply. The tips are built-up 3/16-inch-thick medium balsa and shaped to a mild under-camber.

inverted flight and a brief knife-edge. Its inherent stability produced excellent spin recovery and steady, scale-like, controllable landings—all on a rainy, gusty Saturday and on a dry, but gustier, Sunday.

I hope that the accompanying construction photos support my claim that this project is really nothing more than an elaboration of basic building techniques used in rubber-power construction. Except for some of the external details, the model is easily within the reach of modelers with average building skills.

In Part 2, Dave Baron will report on the D.I's flight performance, and I'll highlight more of the construction details and explain some of the techniques used to bring the D.I to life.

**Addresses are listed alphabetically in the Index of Manufacturers (for page number, see table of contents).* ■

NOTABLE MODEL FEATURES

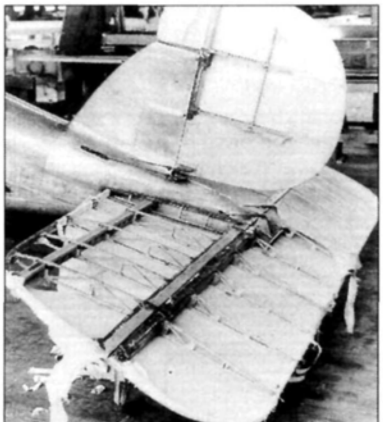
- Accurate rivet patterns on all MonoKote* chrome surfaces.
- Steel-wool-rubbed panels to simulate dural skin.
- Full cockpit details and a servo-operated joystick, rudder pedals and pilot.
- Accurate BMW dummy engine and a scale, removable engine cowl.
- Bungee-cord, shock-absorbing landing gear and tail skid.
- Scale, dural, filleted horizontal stabilizer.
- Scale cable controls.
- Hand-painted, three-color hexagonal camouflage on fabric sections.

DEVIATIONS FROM (EXACT) SCALE

- Wingspan was increased to 56 inches from the scale 51 inches.
- Tail area was enlarged by approximately 12 percent.
- Simulated, steerable tail skid that still looks scale.

By finishing the D.I in its U.S. Army Air Corps colors of 1921, you can save time, because the fabric sections are in plain doped fabric. I highly recommend the woven Solartex* covering for its scale look and tremendous strength.

This U.S. Navy photo shows the D.I's dural stressed-skin, torsion-box structure in the forward two-thirds of each wing. To reduce weight, the rear third sections were covered with fabric.



Note the rivet detail and fillet shape at the horizontal stabilizer root. The entire rudder and horizontal surfaces are covered with fabric, and the fin is nicely filleted and dural-skinned. Note the redundant double rudder horn and cable and the barely visible original German model designation forward of the stabilizers' leading edge.

Compare this view of the original D.I 1751/18 with our model for proportions and details.

a durable, weather-resistant skin.)

Only six were built, and the photos show the two that were acquired for testing around 1921 and 1922 by the U.S. Army and Navy. Although the last five aircraft had the then excellent BMW IIIa, 185hp, super-compressed, 6-cylinder engine, they were really too heavy compared with the top competitive wood and fabric fighters, such as the Fokker D. VIII. Fortunately, my 40 Astro-powered model demonstrates the feasibility of the original D.I airframe if it had had a lighter, more powerful engine, such as the Allies' Hispano-Suiza. Other features of the D.I included the world's first fully adjustable pilot's seat and fuel tank that could be jettisoned. (see photo above).

Although recognized as a very promising fighter by knowledgeable officials, development of the Dornier D.I ended in October 1918 with the November armistice.

CENTER ON LIFT

MICHAEL LACHOWSKI

CENTERING THERMALS & SCALE SOARING

THERMALS ARE a challenge to find. This month, I'll show you several methods you can use to make the most of the thermals in your flying. For all the scale buffs, I'll tell you about how to get a great book on vintage sailplanes and about some organizations that are excellent resources for locating fellow scale enthusiasts and documentation sources.

CENTERING THERMALS

Everyone is familiar with circling in thermals and soaring in the lift. Assuming you have found lift by searching or just borrowing it from a friend, a competitor, or a bird, how do you get the most out of the lift? The best place to fly is where the lift is strongest. How do you find the area where the lift is the strongest, and how do you stay there? The most accepted technique for flying in a thermal is to fly in a circle. To search out the best lift in the thermal, we have to displace the circle, move the sailplane toward the strongest lift and then maintain the circle and the climb.

I'll describe four techniques, and you can pick the approach that works best for you. All of them depend on your ability to determine the rate of climb so that you can recognize the strongest lift conditions. Knowing which kind of climb to expect in different flying conditions requires practice and experience.

In your search for the best lift, you want to maneuver the sailplane toward the area you believe has the strongest lift. These techniques are flight patterns that allow you to maneuver toward this lift while maintaining circling flight.

FLYING STRAIGHT

One simple method is to level the wings, fly straight for a short distance and then start circling again (see Figure 1). The problem with this method is that you have to know in which direction you want to move. This approach works well if there are other models in the same thermal that are clearly doing better than yours. If you're not sure where the lift is, you can inadvertently fly out of the thermal. To avoid this, try to remember where you were circling so, if the need arises, you can return to the lift. Unless you're very sure of the direction, use one of the other techniques.

CIRCLE LEFT AND RIGHT

According to the "Old Buzzard's Soaring Book," another simple way to do some searching is to fly in a figure-8, i.e., make one circle in each direction (see Figure 2). Then you can go with the best side of either circle. This might be nice when you enter a thermal. It's a less than ideal maneuver, however, because you have to apply plenty of control input to reverse direction, and this reduces your efficiency. Full-scale soaring books don't even mention this pattern.

TIGHT HALF CIRCLE

If lift seems weak on one side of the thermal, you can fly half a circle with the plane banked at a steeper angle, and increase the bank when you're entering the weak side of the thermal (see Figure 3). After completing the half circle, resume your normal bank angle. This technique quickly moves your sailplane out of the weak lift and back into the stronger

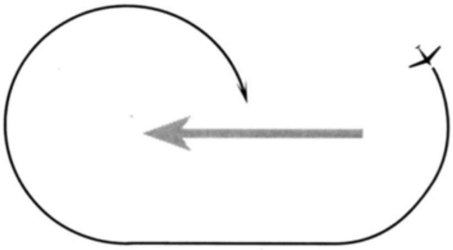


Figure 1

If you're sure you can locate a stronger lift, you can move your sailplane in that direction by flying straight for part of the circle.

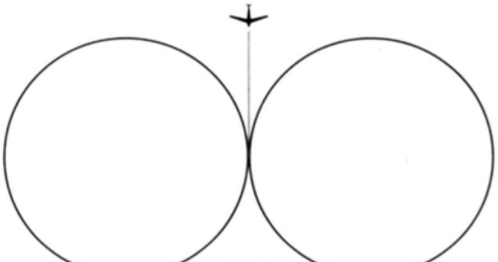


Figure 2

A figure-8 pattern can be used to check if lift is stronger to the left or right, but it requires drag-producing control inputs to complete this maneuver.

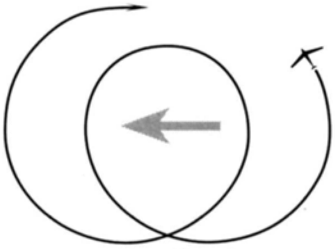


Figure 3

A tight half circle in weak lift moves the sailplane toward the stronger lift with a minimum of control inputs.

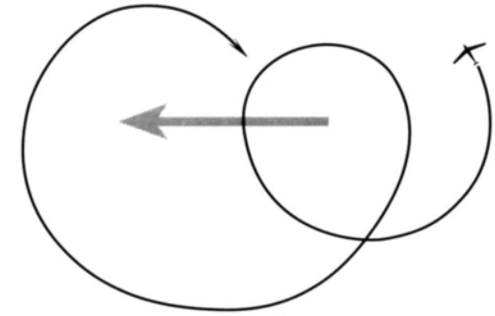


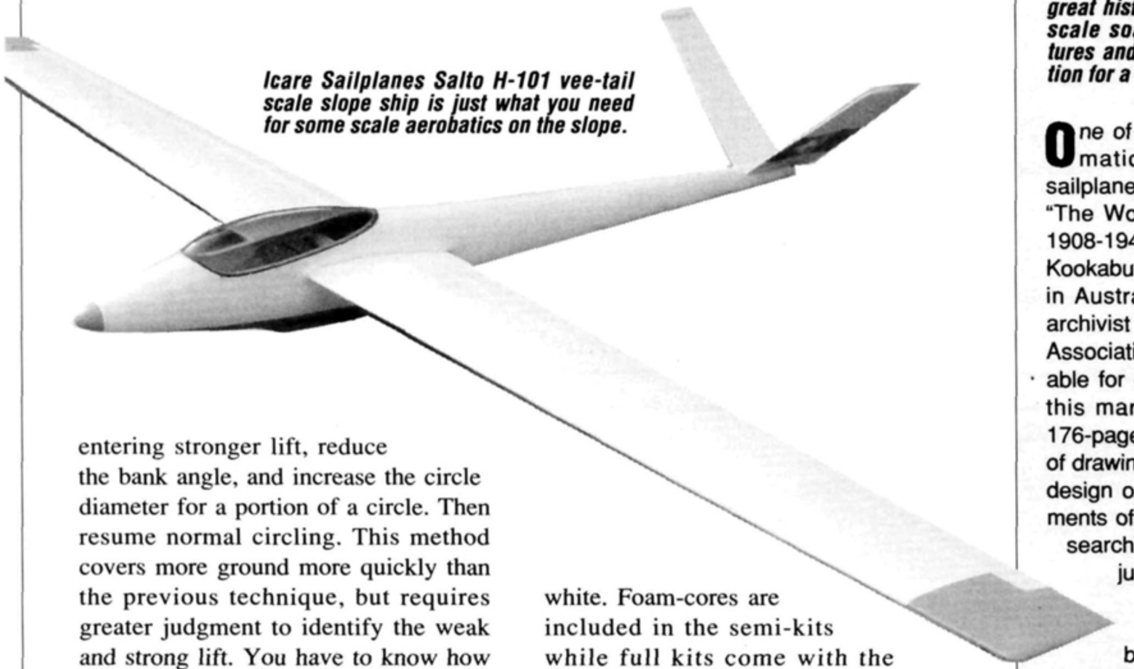
Figure 4

To move the sailplane quickly toward the strongest lift, vary the circle's diameter according to lift strength. Fly in a smaller circle for weak lift and a larger circle for strong lift.

part. This is better than the circle-right-and-left (figure-8) method, since it's more likely that your plane will move in the correct direction to the stronger lift. It keeps you in a bank and doesn't move too far from the lift if you make a mistake. This technique is great for correcting the problem of drifting downwind too slowly. When the lift seems to be dying, make a sharp turn on the upwind side of the circle. You'll find your sailplane is now farther downwind and, hopefully, in stronger lift.

MODIFYING BANK ANGLE

The best method combines the previous technique with reducing bank in strong lift so that you get to the best lift quickly (see Figure 4). As in the previous technique, fly a more steeply banked half circle in the weak side of the lift. Upon



Icare Sailplanes Salto H-101 vee-tail scale slope ship is just what you need for some scale aerobatics on the slope.

entering stronger lift, reduce the bank angle, and increase the circle diameter for a portion of a circle. Then resume normal circling. This method covers more ground more quickly than the previous technique, but requires greater judgment to identify the weak and strong lift. You have to know how your sailplane will respond in the lift. Good luck trying these techniques!

VINTAGE AND SCALE SOARING

Vintage soaring enthusiasts should contact the Vintage Sailplane Association*. It offers an excellent newsletter, "Bungee Cord," that will keep you up to date on VSA news, restoration projects and activities related to the preservation of soaring history. You can get a sample issue for $1, and membership is $15 a year. For modelers of antique sailplanes, Richard Tanis is organizing the Vintage Sailplane R/C Association*. This organization is dedicated to the research, building and flying of vintage R/C sailplanes and antique model gliders. If your scale interests are more general, there is the North American Scale Soaring Association (NASSA)*. Membership dues are $10 a year, and a bimonthly NASSA column is published in *R/C Soaring Digest* (RCSD)*.

If you're looking for some interesting scale projects, check out the Icare Sailplanes* catalogue. Etienne Dorig has an excellent selection of scale ships in a variety of sizes. You can purchase semi-kits or full kits. Fuselages are epoxy-fiberglass and can be colored white. Foam-cores are included in the semi-kits while full kits come with the obechi sheeting completed. Two recent additions are an 82-inch ASW-19 and a 53-inch Salto H-101. The Salto, which is an aerobatic sailplane, should be a really fun slope soarer.

Scale sailplanes are much more popular in Europe. One source of these fine, all-composite models in the USA is Windspiel Models*. They have scale ships in various sizes and designs, including an ASW19, an ASW 20L, a PIK20 and even a 6.25-meter ASH25! A full-color catalogue in English is available for $10. Have some fun with scale ships. I'll see you next month.

**Addresses are listed alphabetically in the Index of Manufacturers (for page number, see table of contents).* ■

VINTAGE SOARING BOOK

Martin Simon's book provides a great history of the evolution of full-scale soaring. The drawings, pictures and text are great documentation for a vintage scale project.

One of the best sources of information on older, full-size sailplanes is Martin Simon's book "The World's Vintage Sailplanes, 1908-1945." The book publisher is Kookaburra Technical Publications in Australia. Raul Blacksten, the archivist for the Vintage Sailplane Association now has copies available for only $55—a real steal for this marvelous publication. The 176-page book is a treasure trove of drawings, photos, technical data, design objectives and accomplishments of many sailplanes. If you're searching for a scale project, or just interested in the history and development of full-size soaring, this book is a necessity.

BIPLANES

(Continued from page 70)

gives the upper wing more incidence—negative decalage—the lower wing more incidence.

Positive decalage gives more of the maximum lift to the upper wing and delays the stall of the lower wing to a higher angle of attack, acting like a lot of positive stagger. On the downside, it also slightly lowers the combined maximum lift coefficient of the two wings. Negative decalage, although less commonly used, has just the opposite effect: it slightly increases the maximum lift. Theoretically, negative decalage, by making the lift of the two wings more equal, should reduce drag, but this has not been borne out by experiment. Drag was very slightly reduced by a little positive decalage.

Positive decalage, especially when used with positive stagger, also has a stabilizing influence, tending to make the nose rise as air speed increases (good in a trainer, but bad for aerobatics). This helps to permit the use of a slightly smaller horizontal tail, although at a rather uneconomical cost in terms of lift and drag.

On a bipe with positive stagger, more of the lower wing surface operates in the downwash of the upper wing, reducing its effective angle of attack and its lift. Positive decalage increases this effect. The chief benefit of positive decalage—a softer stall—may detract from clean entry to inside spins and snap rolls. Locating the CG well aft aids aerobatic line-holding accuracy but may also cause pitch sensitivity at high speeds. A little negative decalage may help such a model.

In a vertical dive, with the wings developing zero net lift, a partial vacuum appears between the upper and lower wings. This is a result of the mild venturi effect created by the convex surfaces of the adjacent airfoils. This tends to suck the two wings together with a force that may exceed the weight of the aircraft.

At full speed, straight and level, owing to the venturi effect, the lower wing of a typical bipe flying at about four times its stalling speed may carry nearly all the lift while the upper wing loafs. As the angle of attack is increased, the upper wing rapidly takes over, developing about 10 percent more lift than the lower wing at higher lift coefficients (Figure 5).

On my bipe designs, I have put the inter-wing suction to good use by using plug-in interplane struts without positive retention. They make field assembly easier

(Continued on page 102)

PHOTOS BY TIM DIPERI

Wes Suggs calls for Tom Dooley.

THE SCHLÜTER CUP helicopter contest is one of the oldest, most recognized heli contests on the scene. The event has been held in many countries over the years—currently, there are 12 countries participating. Past participants have told me that the European contests, which include a task-type competition as well as an FAI competition, are considered to be at the top level of competition. The Schlüter Cup in the U.S. is identical to the AMA Nats approach—competition includes FAI, AMA and scale divisions. Unlike the European contests, there is no fun-fly event.

Ray St. Onge flies Schlüter's flagship—the Futura.

USA

Schlüter Cup

TOP-LEVEL FAI AND SCALE COMPETITION

by TIM DIPERI

Since I attended my first Schlüter Cup in 1987, this contest has become one of the best-attended R/C helicopter events in the country. Almost all of the top pilots have attended this contest at one time or another throughout the years.

This event was no exception in attracting national talent, except for a couple of pilots (Wayne Mann and Wendell Adkins) who were preparing for the World Champion-ships in Austria (where the U.S. team took first).

As usual, Dave Ramsey directed an excellent contest. Two flight lines were used, and the transmitter impound was located between them for accessibility.

Class III competitor Tom McAteer with his Hirobo Eagle.

RAINY START

I arrived on Saturday morning prepared to fly a round of FAI, but I found it difficult to hold an umbrella and do the top hat! The rain stopped after a few hours, and the weather was great for hovering. The Class I and Class II guys started up and got under way on the number-two flight line.

The field layout.

We started FAI shortly afterward. It was great hovering, but when it came to the aerobatics, the ceiling was low—very low! Even though the weather was poor for high aerobatics, it was great for scale flying, which started in the early afternoon. There was a large turnout in Scale this year (the Schlüter Cup usually has more scale competitors than the U.S. Nationals). All the other classes (except for FAI) got in a full day of flying—with no wind.

Sunday was beautiful and clear; it started out calm and cool. By the time I was ready to fly, the wind had picked up enough to almost tear down the judges' tent.

I'm happy to say that I didn't see any mishaps. There were only two close calls: Stan Oslaski's heli disappeared into the clouds, but when it came out, he was in full control. Robert Gorham, flying a borrowed X-Cell (distributed by Miniature Aircraft*), was in a rolling stall turn when his engine quit. This resulted in an autorotation landing at quite a distance from where he stood. His saving technique earned him the Pilots' Choice award. Robert was there for Futaba*, to assist with the new 9-channel systems that are now so popular among heli fliers.

EQUIPMENT FLOWN

As for the equipment used at this event, nearly all the helicopter manufacturers were well-represented. The top six FAI pilots flew an X-Cell, two Hirobo* Eagles, a Concept (distributed by Kyosho*), a Schlüter* Futura and a Kalt*.

Frank Heinrich, general manager and vice president of Robbe Model Sport USA, and Dave Ramsey (right) at the awards ceremony.

PILOT	HELICOPTER
FAI	
1 Cliff Hiatt	X-Cell
2 Tom Dooley	Hirobo
3 Stan Olzaski	Kyosho
Class III	
1 Dana Swah	Kalt
2 Lance Murphy	X-Cell
3 Ralph Dalusio	X-Cell
Class II	
1 Handi Homann	X-Cell
2 John D'Arcangelo	X-Cell
3 Lance Frohman	Kyosho
Class I	
1 Tony Hamdi	Kyosho
2 Paul Drajem	Robbe/Schlüter
3 Robert Burgo	Robbe/Schlüter
Scale	
1 Michael Armocida	Robbe/Schlüter
2 Al Smith	GMP
3 Mike Swift	Hirobo

Regardless of your skill level, consider this event a must if you can get to it. The next Schlüter Cup will be held on September 17 and 18 at the West Windsor Flying Club in Windsor, NJ.

About 70 percent of the radio equipment was made by Futaba, and the rest was split between Airtronics* and JR*. The ever-popular Morgan* (Cool Power) fuel was the popular choice.

Overall, the event ran smoothly with no problems and few complaints. Regardless of your skill level, consider this event a must if you can get to it. The next Schlüter Cup will be held on September 17 and 18 at the West Windsor Flying Club in Windsor, NJ.

**Addresses are listed alphabetically in the Index of Manufacturers (for page number, see table of contents).* ■

HOW TO

Landing Gear Design, Part 2

by ANDY LENNON

GEOMETRY YOU CAN USE

Figure 1. The Crane II in a nose-high posture, about to touch down, flap extended.

THE CENTER OF gravity location, in both the horizontal and vertical senses, is the focus around which the landing-gear geometry is established. For model aircraft, the only cause of a CG shift during flight is the reduction in the weight of the fuel as the flight progresses. For a conventional model, this causes a rearward shift of about 3 percent of the mean aerodynamic chord (MAC). For a rear-engine canard, the fuel tank is typically behind the CG so that a similar, but forward, CG shift occurs. The vertical CG location is usually "eyeball" estimated. It is better to get it a bit higher than lower.

There are two major types of landing gear:

Tricycle: the CG is ahead of the main wheels, and the nose wheel is steerable (see Figure 1).

Tail-dragger: the CG is behind the main wheels, and the tail wheel is steerable (see Figure 6).

Bicycle landing gear is a variant of tricycle gear; a single rear wheel replaces the normal tricycle main wheels; the front wheel is steerable, and tricycle geometry applies.

The single-wheel CG of some sailplanes is a variation on tail-dragger style and geometry. The high tail angle is not needed because there is no prop, and these gliders land in a nearly horizontal attitude.

LANDING-GEAR DYNAMICS

• **Tricycle gear.** On the landing or takeoff run, tricycle landing gear, with the CG ahead of the main wheels, is self-correcting directionally (see Figure 2 A and B). The nose wheel steers, prevents the plane from "nosing over" and protects the propeller.

When a "trike"-geared model tips backward so that the tail skid rests on the ground, the CG rotates with it. If this rotation brings the CG behind the wheel axles, the model will stay tail-down—a most undignified posture! Shifting the landing gear rearward from the CG by 5 percent of the MAC, as shown in Figure 7, prevents this from occurring.

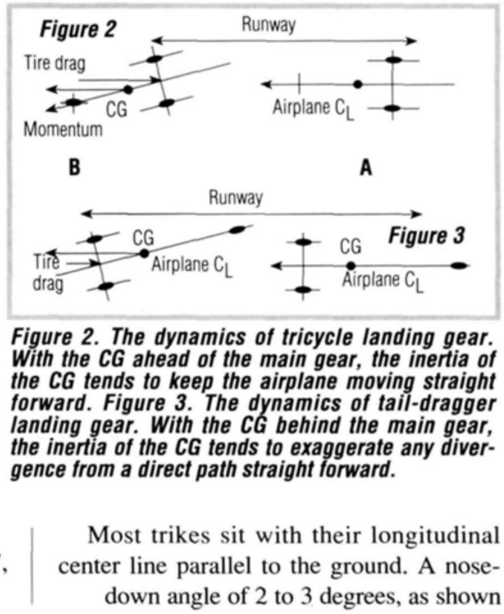


Figure 2. The dynamics of tricycle landing gear. With the CG ahead of the main gear, the inertia of the CG tends to keep the airplane moving straight forward. Figure 3. The dynamics of tail-dragger landing gear. With the CG behind the main gear, the inertia of the CG tends to exaggerate any divergence from a direct path straight forward.

Most trikes sit with their longitudinal center line parallel to the ground. A nose-down angle of 2 to 3 degrees, as shown in Figure 7, is suggested. On landing, after the nose-wheel has made ground contact, this nose-down angle will bring the wing close to its angle of zero lift. The model will tend to cling to the ground. The potential for nose-gear damage is reduced, and experience has proved that this nose-down attitude has no adverse effect on takeoffs.

Figure 13 illustrates the trike geometry for a rear-engine canard. Obviously, a very high thrust line is needed to avoid the need for an unduly long landing gear for prop-tip protection. The

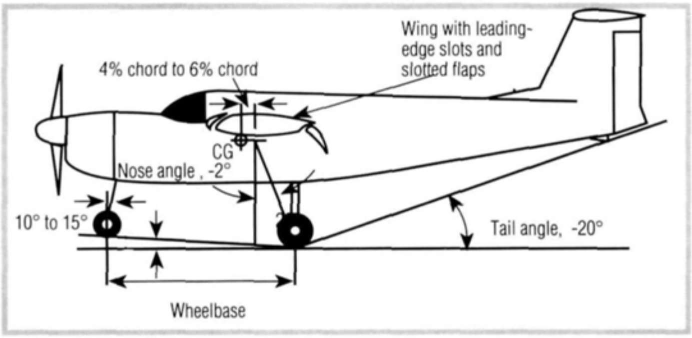


Figure 4. Fuselage upsweep required to obtain a high tail angle and a short landing gear. This drawing shows the Crane, which was designed by the author.

Swan canard (Figure 12) illustrates this point. For such craft, add 5 degrees to the tail angle.

Figure 4 shows how fuselage upsweep may be used to reduce the length of the landing-gear legs for models that require large tail angles (such as the Crane shown in Figure 1).

This high tail angle moves the wheel axles farther behind the CG and requires heavy up-elevator deflection to rotate the model for takeoff; but as the tail goes down, the wing's lift ahead of the CG aids the model's rotation for quick takeoffs.

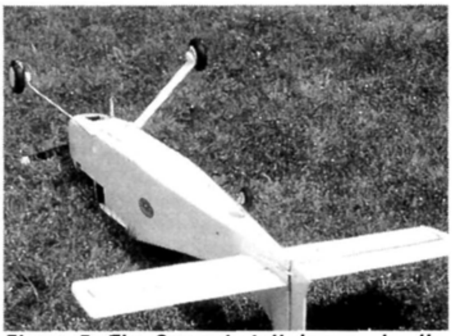


Figure 5. The Osprey's tail-dragger landing gear—upside-down.

• **Tail-draggers**. As soon as a tail-dragger's speed, on takeoff, permits the tail wheel to lift off, it becomes directionally unstable (see Figure 3 A and B). The CG wants to get ahead of the main wheels (Figure 3 B). Coarse rudder application is needed for directional control on takeoffs and on landings.

As the tail comes up, propeller torque and gyroscopic precession cause the model to veer. Compensating rudder is applied until the aircraft is just airborne.

If liftoff is forced by heavy up-elevator action, and the model has ample dihedral, and coarse rudder is still applied, a sudden snap roll may occur. Unless your reflexes are very quick, a damaging and embarrassing crash will occur. It has happened to this author!

Another disadvantage of a tail-dragger is its tendency to nose-over, which is hard on props! Moving the wheels farther forward to reduce this tendency aggravates the model's directional instability on the ground. Figure 10 shows the author's Osprey—a tail-dragger—in an undignified tail-up position. To avoid this nosing over, taxiing, particularly on grass, should be done holding full up-elevator.

DETAIL DESIGN

Figures 6 and 7 illustrate the procedure for positioning the main landing-gear wheels for both trikes and tail-draggers. Take the tail angle described in Part 1 and, on a side view of your design, draw a line *that defines the tail-angle to the horizontal*, originating either at the tailskid or at the tail wheel.

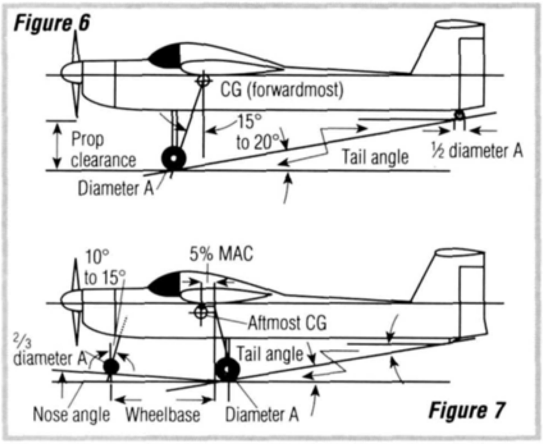


Figure 6. The geometry of tail-dragger landing-gear design. Figure 7. The geometry of tricycle landing-gear design.

• **Tricycle gear.** To prevent the model from sitting back on its tail, follow this procedure. Draw a vertical line through the point that is 5 percent of the MAC behind the CG. Draw a second line through this point that defines the tail angle to the vertical line just drawn (see Figure 7). Notice that this tail angle is the same one as that defined by the line drawn from the wheel to the skid. Where these two tail-angle lines intersect, draw a horizontal line forward to the nose-wheel position, and then draw a short vertical line upward from the same intersection. The main wheel axles should be on the short vertical line, with the wheels' outside diameter resting on the horizontal line. Decide whether a nose-down angle is to be used, and if it is, draw the nose angle at 2 to 3 degrees to the horizontal line. Nose and tail gear will be discussed later.

• **Tail-dragger.** Draw a line at 15 to 20 degrees from the CG, in front of the vertical, as in Figure 6. Where the two lines intersect, draw both horizontal and vertical lines. The main wheels' outside diameters should rest on the horizontal line, with their axles on the vertical.

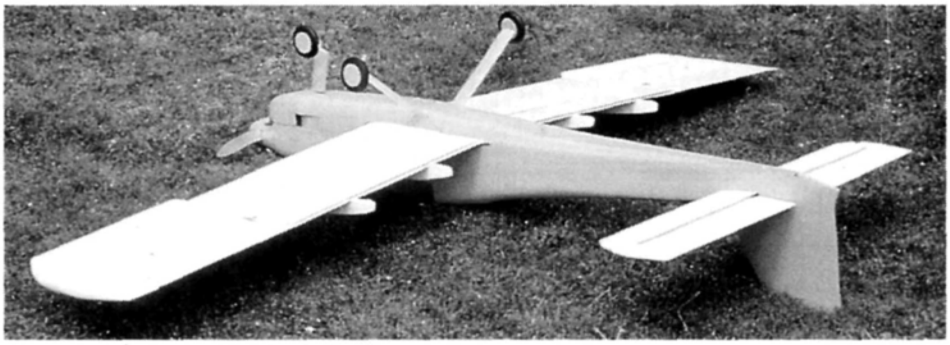


Figure 8. The SeaHawk's tricycle landing gear—also upside-down.

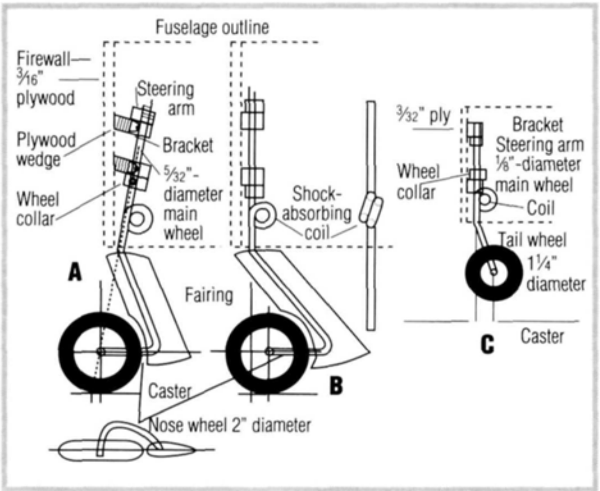


Figure 9. Nose- and tail-gear detail. Two arrangements for a nose wheel and one for a tail wheel.

TREAD WIDTH

Both trike and tail-dragger landing gear should have a lateral spacing ("tread width," or the distance between the center lines of each tire) of 25 percent of the wingspan of an aspect ratio 6 wing (see Figure 11).

If the wing has a higher aspect ratio, calculate what the span would be for aspect ratio of 6 with the same area. The formula for aspect ratio equals span squared divided by the area. Knowing that the aspect ratio is 6, and knowing the formula, the wing area of the imaginary span can be easily calculated; and the wheel-tread dimension will be 25 percent of that span.

STATIC LOAD SQUAT

Models with music-wire or aluminum landing-gear legs originating in the fuselage and sitting on the ground bearing the model's

gross weight (IG) will "squat." For .40 to .50cid-powered models, this squat is about 1/2 inch and reduces the tail angle for takeoff. To compensate, reduce your landing gear legs' "included angle" (see Figure 11) to lower the wheels and compensate for the squat.

WHEEL DIAMETER

Smaller wheels have less air drag. For paved runways, a 2-inch diameter is the recommended minimum; for grass, a 2¼- to 3-inch diameter is suggested.

Figure 10. The Osprey—nosed over and with flaps down after landing. Its clean aerodynamic design is evident.

NOSE- AND TAIL-WHEEL DESIGN

Steerable nose- or tail-wheel gear should incorporate a modest amount of caster. A modest amount of offset, as in the case of a grocery-cart caster wheel, facilitates steering. Similarly, in the case of landing gear, such gear tracks well and permits easy steering. Too much offset invites "shimmy." An offset of 20 percent of the wheel's diameter is sufficient. Figure 9 illustrates two nose-wheel arrangements (A and B) and one for a tail wheel (C).

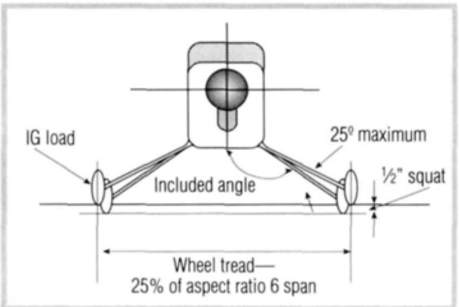


Figure 11. Wheel tread and squat detail.

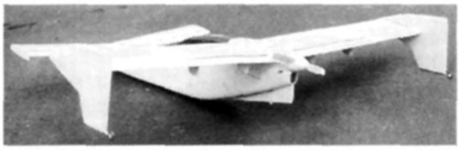


Figure 12. The Swan canard. The bicycle landing gear is hidden by the fuselage, but the wingtip wheels show. Note the high thrust line.

The nose-wheel gear is mounted on the rear surface of the ply engine-mount bulkhead. For a conventional design, this determines the position of the nose gear.

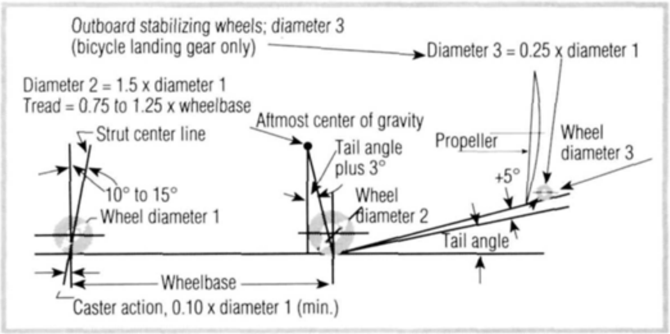


Figure 13. Layout geometry for tricycle or bicycle landing gear for a pusher canard.

For a canard with a rear engine, the nose wheel should be well forward, as in Figure 13. Note that, in Figure 9, A and B, the shock-absorbing coil is totally enclosed in the fuselage to reduce drag.

For tail-draggers, this author prefers the somewhat forward tail-wheel location shown in Figures 10 and 5, with the tail-wheel leg supported internally by nose-wheel brackets bolted to plywood, as in Figure 9 C.

MAIN LANDING-GEAR LEGS

Main landing-gear legs should be a continuous piece of metal from wheel to wheel so that bending loads do not have to be absorbed by the fuselage structure, but are contained in the landing-gear legs themselves. Figure 5 illustrates the Osprey's aluminum tail-dragger gear. The 5/32-inch-diameter axles are from Du-Bro*. The tail wheel, which is offset to provide caster, is visible.

Figure 8 is an upside-down photo of the Seahawk's trike gear of 5/32- inch-diameter music wire, faired with balsa and plywood for drag reduction. The wheels are Williams Bros.* smooth contour line of 2¼ inch diameter. This concludes my series on landing-gear design. Hopefully, it has been interesting and informative. Happy landings!

** Addresses are listed alphabetically in the Index of Manufacturers (for page number, see "Contents").* ■

BIPLANES

(Continued from page 87)

and, because they aren't securely fastened to the structure, they're unlikely to cause wing damage in a mishap. The use of positive decalage would reduce the suction and increase the possibility of the struts coming adrift in flight. A small amount of preload (provided by making the struts a little longer than required to just match the gap) makes the struts "spring" the wings apart just a little.

FLAPS ON BIPES?

Wing flaps are relatively rare on biplanes. Their wing loading is usually considerably lower than that of monoplanes, and their glide angle tends to be steeper so they have less need for flaps. In addition, flaps don't work as well on bipes.

Depressing a flap on the upper wing interferes with the airflow over the upper surface of the lower wing and tends to reduce its lift. If the upper and lower wings are equal in size, having flaps only on the upper wing will increase the total maximum lift by only about 10 percent. Flaps on both wings will increase maximum lift by 35 to 40 percent—about two-thirds as much as for a monoplane. For the best results, flap travel on the upper wing should be only a little more than half that of the flaps on the lower wing.

If only one wing is to have flaps, the lower wing is the better candidate. This increases total wing lift by about 20 percent in an equal-winged bipe, i.e., one on which the wings have the same aspect ratio and area.

WING INCIDENCE

Bipes are no different from monoplanes with respect to the effect of wing incidence. Bipes are nearly always tail-draggers (no nose wheel) and, like all tail-draggers, they have been known to be a little squirrely on the ground, particularly on a hard surface (just ask any Pitts pilot). Many full-scale bipes use positive incidence to lower the nose in flight (giving the pilot a better view) and to allow a three-point landing at absolutely minimum air speed.

Positive wing incidence makes the tail fly a little higher. During takeoff, the tail lifts earlier, and you lose tail-wheel assistance in tracking, so ground looping is more likely. I never use incidence on my own non-scale designs, but I do have a strong affection for sub-fins and sub-rudders. These reduce the angle of attack of both the wing and the tail while taxiing—something that helps to keep the tail wheel firmly planted throughout the takeoff and landing roll. Ground looping has never

(Continued on page 104)

BIPLANES

(Continued from page 102)

been a problem, even in a nasty crosswind, because on landing, the tail wheel tends to touch first and yank the bird into alignment with the runway. Sub-fins and sub-rudders place more vertical tail area in clean air, below the swath of very dirty air that tends to hurt bipe-tail effectiveness. They promote friendly handling at critically low air speeds

In Part 2, I'll discuss tapered wings, ailerons, dihedral, bracing wires, triplanes, fun-fly designs and more. See you then! ■

AIRWAVES

(Continued from page 9)

The purely electrical losses in the motor are handled by what Mitch calls "armature resistance," which actually also includes resistive losses in the brushes. Mechanical losses, such as brush friction and bearing friction, must also be accounted for. Some people invoke a fictional current, called "no-load current," to account for such losses. Our lab tests indicate that this parameter is erratic and unreliable, and we don't use it. Instead,

(Continued on page 120)

HAL DeBOLT

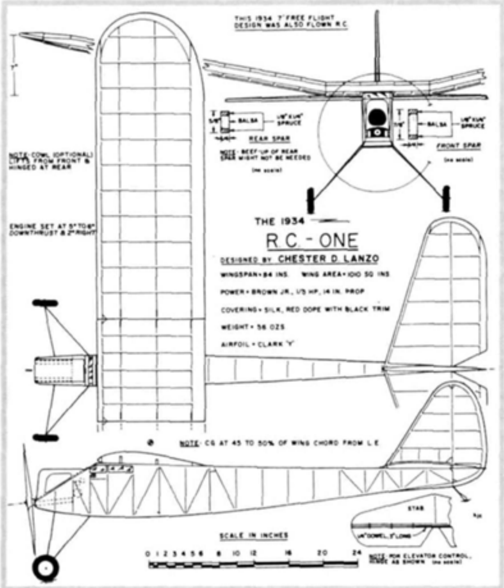
THE DAWN OF R/C

THIS IS THE beginning of a series that will trace the evolution of R/C models. It should answer many questions about why things are the way they are and also provide a flavor of the personalities involved. Along the way, I'll find distinct points at which considerable changes and advancements occurred. You might wonder whether we'll ever see such milestones, such as ducted-fan "jets," again. My bet is we will.

This replica R/C 1 by Tom McCoy displays remarkably modern lines.

RADIO-ACTIVE AGE

We should realize that the R/C pioneers' major effort had to be the radio gear. Also, this was the heyday of free-flight and cabin-style designs. It was convenient for the experimenters to test their radios in the available free-flight models. This discussion won't cover who flew R/C first; we went that route in an earlier "Golden Age" and came up with the "chicken or the egg" argument between Good and Lanzo.



Chester Lanzo's R/C 1 three-view.

There seems to be no question as to who designed and built the first R/C powered model—Chester Lanzo with his R/C 1 in 1934. When you compare this OT model with today's popular Sig Kadet Senior and Hobby Lobby's Telemaster, you'll be reminded of the old adage, "What goes around comes around."

I was fortunate to be able to model with Chet, and we discussed the R/C 1. Apparently, it was a project that lasted several years and culminated in Chet's winning the first R/C Nats in 1937. He was a champion modeler in rubber-powered free-flight; his cabin-style designs were winners. His early gas-powered designs were extensions of his success with rubber power. Early free-flight power events used "allotted fuel," but this resulted in extensive flights that led to many models being lost or damaged. Those $21 engines were precious during the Depression! Chet concluded that if he could control the model, it could land safely. The long chases that were the order of the day could also be eliminated. R/C seemed to be a logical approach.

Lanzo lands his replica R/C 1 in the '60s; it performed well with a radio. The original was destroyed when he attempted to control it with a Marconi-era radio!

A SPARK OF GENIUS

Chet had little knowledge of electronics, and no one had found a way to reduce the cumbersome size and weight of the current radios to suit model aircraft. So it was off to the library for study. He determined that the earliest method of radio transmission might be more adaptable than the new-fangled tubes. Such a transmitter was simply a sparking coil that energized a tuned circuit; this, in turn, transmitted a radio wave.

The heart of the receiver was called a "Coherer"—a glass tube that was loosely filled with metal particles. When a radio wave was received, the particles would become magnetically aligned and create a circuit within the tube. The closed circuit would then pass the current needed to activate a homemade, relay-like actuator whose arm operated the model's rudder. Note that there's no mention of frequency; the transmitter simply blasted the atmosphere with a broad radio wave! Want to try it today? You can imagine the time and experimentation it took for Chet to make this system work.

When the system was finally operational, Chet determined that he could do

better with a model that had been expressly designed to be controlled (unlike the free-flight models). But think, what criteria do you use for the first R/C model? Note how closely Chet came to some modern designs. Imagine not only developing an R/C system from scratch but also delving into uncharted territory with it. Obviously, the result was the R/C 1. I wonder whether, at the time, Chet ever envisioned R/C as we know it today?

FIRST R/C R&D

The R/C 1 was first flown as a free-flight craft and was stable and docile. Various rudder settings were used, and the R/C 1 responded to each without vice. The stage was set for R/C!

The first attempts with R/C revealed a bugaboo that—to some extent—still exists today. Chet had mounted the receiver's Coherer on the firewall so that engine vibration would "decoherer" it when there wasn't a signal. A good idea—except the engine's ignition noise interfered with the radio wave! Various attempts to cure the problem resulted in about a 100-foot range, which proved to be the maximum for the system. Chet was delighted to get an occasional command through while the model was free flying, but control, to say the least, was less than positive. After the R/C 1 had met its demise on one of these flights, Chet decided that the Coherer system was impractical.

He had a hard time explaining why he abandoned the successful R/C 1 design for the seemingly more antique designs he successfully used later on. His next design, built in 1935, was a 12-foot monster—the Racer. This size was necessary to carry the heavy, tube-style radio equipment he had switched to. Of course, most of us are familiar with his famous "stick" design that won the first R/C Nats and put another feather in his cap.

When he was in his 60s, Chet built an R/C 1 replica and flew it with a modern radio; it was said to be an excellent flier. The design is also approved for SAM (Society of Antique Modelers) R/C-assisted free flight, and reports indicate that many people have found it to be excellent for that purpose.

If you analyze the R/C 1, you'll find that its general design is different from most of the free-flight models of that era—distinct enough to set it apart. The fuselage wasn't as bulky as the norm; it was just large enough to hold the radio. Also, note the use of the low-drag Clark "Y" airfoil; others used the deeply cambered, high-lift varieties. Chet was obviously thinking R/C! As it happened,

CHOOSING THE CORRECT INCIDENCE

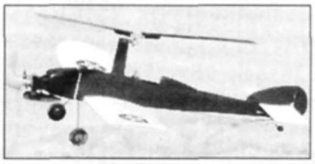
A while back, I discussed VK Models and my old friend Vern Krehbiel. I wondered which was the first VK R/C kit? After I had moved to Florida, I lost contact with Vern, but he responded to say that he's still active. He sent some photos that you may appreciate.

A happy Vern Krehbiel after test-flying the prototype VK Sopwith Camel in the '60s; it's now a Proctor kit.

My question concerning the proper incidence angle for autogyro rotor blades calls for some clarification. Rusty Russian of Grandview, MO, tells us he has been flying two rotor-system model gyros and will soon be flying a *Model Airplane News* gyro. He says that several full-scale machines that used power for pre-rotation had positive blade incidence. This seems to substantiate the Kellett drawings I questioned earlier, but it doesn't explain the difference I noted.

This question came up when Ron Clem of San Diego, CA, told us that his heli experience prompted him to use positive incidence in the blades of his *Model Airplane News* gyro—even though the plans called for negative. The gyro didn't have lift until he switched the incidence angle to negative; he has enjoyed fine flying ever since.

A possible explanation comes from Steve Young of California, who has been digging into the archives for autogyro engineering data. What he found sounds about as logical as feathers on a horse—but then tell that to Tri-Star pictures! Briefly, the info he found indicates that rotor blades with spans of less than 6 feet will only produce lift with negative incidence, but full-size blades will produce lift with positive incidence. He notes that some versions used a negative angle for the first 6 feet and progressed to positive. Thus we have an explanation, but it will take a better aerodynamicist than I to explain it all. It's a good subject for "tech types" to contemplate!



Ron Clem's "Model Airplane News" autogyro drops for another landing. Using the specified negative blade incidence solved the lift problem.

Finally, a photo of the Mach 1—the first VK R/C kit. Note the sweptback wing—mighty daring for those days!

Remember, this is your OT R/C place; let's hear from you, too!

these basic design concepts were used by many R/C'ers until the early '50s, when experience dictated what was actually needed. Of course, what stands out is the use of the free-flight "stick structure," but then what else would be expected from a champion free flier?

OT R/C ORGANIZATIONS

It seems timely to remind you of two growing OT R/C organizations. If you're active in OT R/C, or you find it interesting, you would do well to become associated with them. They have different intents and objectives, and each offers something different and rewarding. Best of all, you don't have to be an expert to participate!

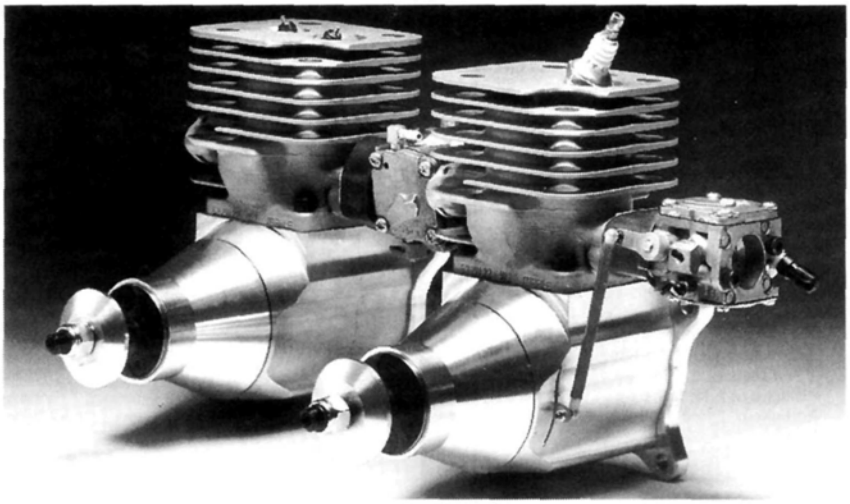
The larger of the two is the Vintage R/C Society (VR/CS), which has well over 300 members. They fly OT R/C designs for pleasure and to show how flying was done in the early days. Some fliers have originals, but most are replicas. The VR/CS offers an outstanding newsletter, edited by Art Schroeder, and sponsors an annual Selinsgrove Re-enactment; nearly 50 OT models were flown in the '93 edition, and as many pilots and far more observers attended. It's good stuff! The VR/CS contact is John Worth, 4326 Andes Dr., Fairfax, VA 22030.

The Senior Pattern Association (SPA) has grown steadily during the past three years. It has competitions for senior citizen R/C'ers. There are age categories, and pilots fly R/C designs that originated before 1970. They also use the pattern from the same era. Several meets are scheduled for 1994, including the SPA Masters slated for the fall in Smyrna, GA. At the '93 Masters, more than 40 entrants enjoyed relaxed competition, camaraderie and nostalgic models. The SPA contact is Mickey Walker, 3121 Northview Pl., Smyrna, GA 30080. ■

DAVE PATRICK

GETTING YOUR BIG ENGINE TO SMOKE

IN THE LAST two columns, I showed you how to get great smoke with a pumped YS* 120 4-stroke and with smaller 2-stroke engines. This month, I'll cover making smoke using larger gas engines. It's easier than you may think!



ILLUSTRATIONS BY TEJERA MICROSYSTEMS ENGINEERING

Large glow and gas engines, such as the Infinity 4.4, make smoke easily. Your system needs to deliver enough smoke fluid to do the job.*

HOW BIG IS BIG?

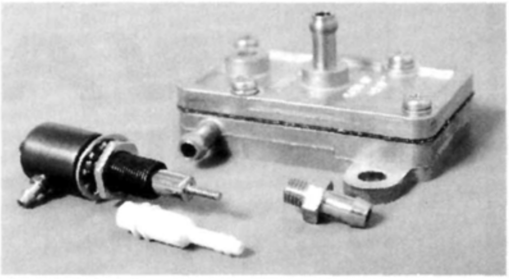
I thought I'd save the easiest for last; big gas engines are really fairly easy to get smoking. First, let's define "big." I would say that any engine larger than 2.5ci is big—especially if it runs on gasoline. Getting enough smoke fluid to the muffler may be the biggest problem you'll have.

The trusty Tejera Microsystems Engineering Inc. (TME*) Simple Smoke Pump works really well for this; it has a large capacity and is very easy to install (Figure 1). You'll need a separate battery to power the pump. Simply plug the unit's lead into a spare channel, e.g., the retract channel, and it's ready to go. The instructions are great. A lot of the information I used to put these articles together came from the Simple Smoke Pump instruction booklet.

DIAPHRAGM PUMPS

Another system, from Bennett*, will also pump enough smoke fluid to the muffler. It uses engine crankcase pressure to operate a diaphragm pump that delivers the smoke fluid (Figure 2). The smoke-fluid flow is controlled by a valve that's operated by a separate servo. With this system, you'll need to install a tap on your engine. You should seek help from the engine manufacturer or someone who really knows what he's doing. I sure would hate to see someone ruin a good engine! The Bennett pump system has been around for a while, and I've seen many used with great results.

The trusty TME Simple Smoke Pump works really well, has a large capacity and is very easy to install. You'll need an extra battery pack to power it, but you can simply plug it into a spare channel in your receiver.



This B&B Specialties Super Smoke Pump is a popular diaphragm system that's used with a pressure tap from the engine crankcase. The large fitting (left) is the B&B Smoke Control Valve.*

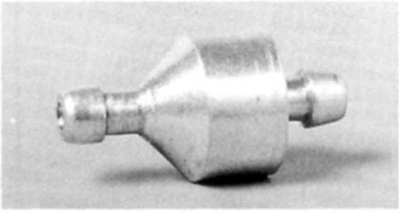
CHECK VALVES

A really simple way to smoke a biggie is to use a simple check valve, such as one from YS or Varsane*, and an on/off valve, such as one from Du-Bro* or the new one from Varsane. Be careful; the YS valve isn't compatible with gasoline, but, although I haven't seen it work in this capacity, I understand that the Varsane check valve is compatible and should work well (Figure 3). (I only recommend systems that I've used or seen used first-hand. I apologize to any manufacturers that I've omitted.) Getting back to smoking, I did see a few people using the check-valve system at the last TOC, and it worked well. It's very simple and light.

HOW IT WORKS

First, you must install a pressure tap in the crankcase as you did for the Bennett system. From here, the pulse pressure goes to the check valve, which eliminates all the negative pulses; the result is only positive pressure pulses. This pressure then simply goes to the smoke-fluid-tank overflow line, which, in turn, pressurizes the smoke-fluid tank. This will be kept at about 4 to 7 pounds of pressure (or so I've been told).

The supply line now goes to an on/off valve to control the flow; then it goes to the smoke chamber/muffler. Because the entire system is under constant pressure, you must make sure that all the lines are



The heart of the simple check-valve smoke system is, obviously, the check valve. This Varsane system isolates all the negative pulses from the engine crankcase and delivers about 4 to 7psi of smoke fluid to the supply tank.

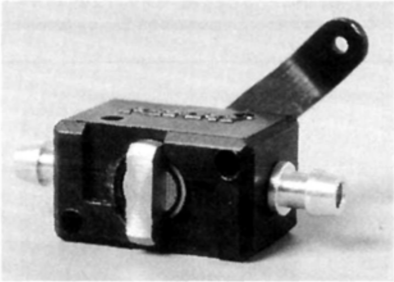
secure and that there aren't any leaks. You may want to add a remote needle assembly, such as the Varsane unit, so that you can adjust the amount of fuel entering the muffler. That's about it. Simple, eh?

SMOKE CHAMBERS

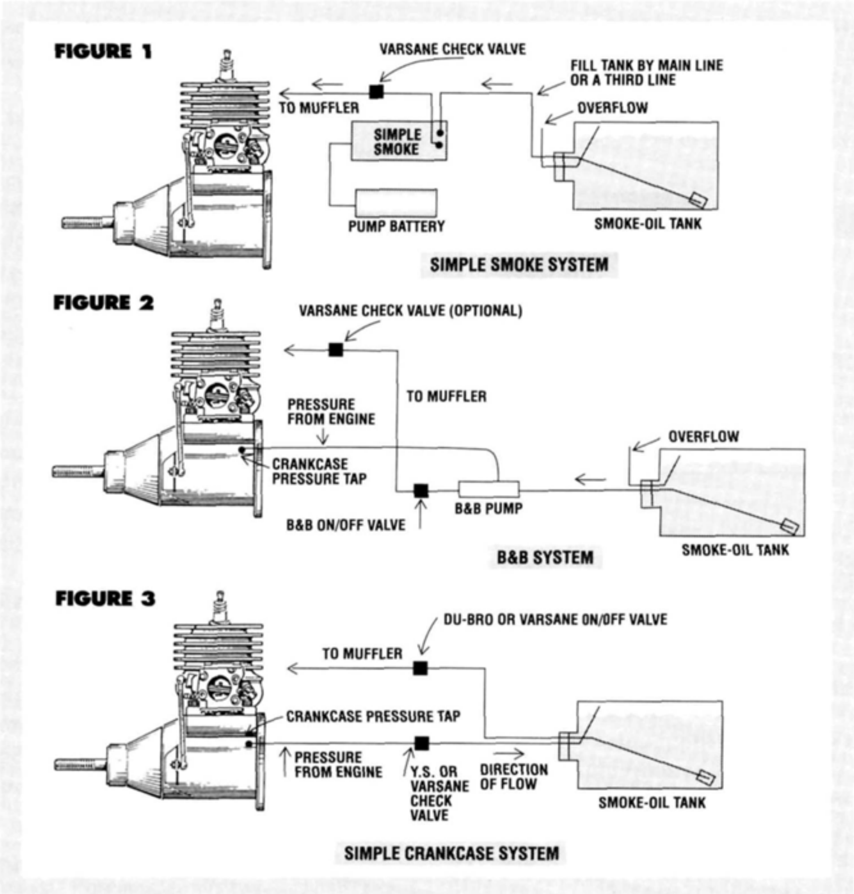
As for smoke chambers/mufflers, the general rule is: the larger the muffler (tuned pipes not included), the better it smokes. This is because it allows a longer "hang time"; the fluid has time to smolder to create a thicker, denser smoke. For example, a straight stack or exhaust deflector won't create nearly as much smoke as a large-volume Slimline* muffler—not to mention the benefit to your ears!

Preheating usually produces better smoke, but as I've said before, big gas engines usually don't need it. The cooler-burning alcohol engines benefit from preheating the smoke fluid if you can install the parts. I've only seen preheating coils on big mufflers done by Slimline, but you can create your own system. I think the most practical way would be the after-muffler coils that were described in my last column.

A smoke-injector fitting can be made out of a length of 1/8-inch-o.d. brass tube and a Du-Bro fuel-cap fitting that have been silver-soldered together.



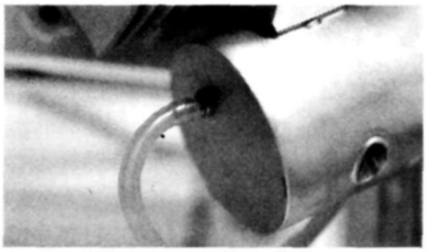
To turn the smoke on and off in the check-valve system, you'll need an on/off valve. This Varsane valve works very well.



IMPORTANT HINTS

It seems as if most engines don't operate well (or simply quit) when smoke fluid is injected into the muffler when the throttle setting is at less than full power. This can prove to be disastrous, so shut off the smoke whenever you throttle down. It's helpful to mix the throttle with the smoke channel in your radio so that the smoke is turned off at any power setting that's less than 80 percent.

Another problem is deciding where to inject the smoke fluid. Experimentation is usually the only way to find the best place, but the hottest location that has the lowest pressure is usually at the narrow section that's between the engine and the muffler body. Also, try not to have the outlet facing into the exhaust flow. Position it at (or close to) 90 degrees (a bit less seems to work best)—something like a needle-valve setup—so that you get good atomization. Sometimes, injecting the smoke too close to the exhaust port affects the engine, prompting it to flame out—particularly at anything less than full throttle. Whatever you do, test the system carefully



Here's the smoke injector fitting on the muffler of my Infinity 4.4 engine. Position the fitting in the hottest area of the muffler that has the least pressure.

to avoid any surprises. Oh, by the way, don't smoke out your neighbors! The amount of smoke a model engine can generate is amazing.

KNOW WHEN TO SAY WHEN

Knowing when to turn on the smoke is almost as important as the volume of smoke you create. If, for example, you simply keep it on from takeoff to landing, the impact will be diminished. So the answer, of course, is to turn the smoke on and off at certain times. You can pick up hints of when to turn the smoke on and off at full-scale aviation air shows.

For example, approach the field with the smoke off; then just before the center, turn the smoke on, perform a simple loop, and when you're back to straight and level, turn the smoke off. Believe me, that simple loop will be a real attention-getter! Now add to that maneuver—keeping it low—and you'll have the beginning of an air show! A simple takeoff, smoke on when you throttle up, and smoke off as you fly away. Get the picture? Timing is everything. Use the smoke to accentuate and add drama to the maneuvers. Experiment and play with it; it's really a lot of fun and adds another dimension to this wonderful sport!

I'd like to thank American Model Products*, TME and especially Don Aliffi of Gulf Stream* for helping to gather all the data on getting smoke from model engines. Don was kind enough to provide actual scripts from his new video, "Smoke On!" Next month, let's get fancy again, and I'll talk about trimming. See ya!

**Addresses are listed alphabetically in the Index of Manufacturers (for page number, see table of contents).*

AIRWAVES

(Continued from page 104)

we prefer to compute the mechanical losses directly from fundamental physical principles.

Incidentally, with all the different ways to account for losses, it's no wonder that everybody's published data on motor efficiency is different from everybody else's!

We agree with Mitch's thrust equation and particularly with his explanation of "form factor" for prop blade shape. This is what other folks call "prop efficiency." We see from Mitch's figures that the efficiency may vary by 43 percent over its range of values for different propellers!

Mitch comments that the gear ratio is a function of the "speed constant." This is correct. We have worked out the detailed physics of gear ratios. The latest version of our program computes the optimum gear ratio for the combination of motor, batteries, and prop the user wishes to test. For example, the optimum gear ratio for a Model Electronics War Emergency Power motor running on 7 cells with a 13x8 prop is 0.21, or about five to one. In this configuration, the prop would turn at 4,775rpm and would produce 33.4 ounces of thrust (for a well-manufactured wooden prop).

As usual, Mitch has done a fine job of reporting and of instructing. We always enjoy reading his articles.

Paul R. Ogushwitz, Ph.D.
President, USR&D
Hackettstown, NJ

*Thanks for your comments, Paul. We'll republish the equations in a future "Electrics" column with the suggested additional parentheses for clarity. Your comments are interesting, particularly with respect to the choices that exist in measuring motor performance. Readers who wish to find out more about AERO*COMP software should contact USR&D, P.O. Box 753, Hackettstown, NJ 07840-0753; (908) 850-4131.* TA

SCALE MARKINGS

I've read *Model Airplane News* for many years, and I've always been interested in scale models. I just love your coverage of all the big national scale meets; in particular, your great write-up on the '93 Top Gun at West Palm Beach, FL. The photos and detailed account were the best of all the mags I've read. Keep up the good work.

I'm building a Pica P-51D Mustang, and I want to duplicate a full-size fighter I saw in a Squadron Publications book. Is

(Continued on page 128)

HOBBY SHOP DIRECTORY

Retailers: Make your business grow with new traffic! Now you can advertise your hobby shop in the ***Model Airplane News*** **Hobby Shop Directory**. The listing will be published monthly and will be listed according to city and state. You have 3 to 4 lines, approximately 20 words, in which to deliver your sales message, plus space for your store's name, address and telephone number.

HOBBY SHOP DIRECTORY SPACE RATE
• $179 per year • $97 for six months • $48.50 for three months—ALL PAYABLE IN ADVANCE
Space reservations must be received by the 10th of the third month preceding publication (for example, January 10th for the April issue).

LATIN AMERICA
Belo Horizonte-Brasil
Completa linha de aeromodelos, carros, barcose helicopteros radio controlados, plastimodelismo,componentes e servicos. Importacão direta.

HOBBY'N WOOD MODELISMO LTDA.
Av. Silviano Brandao 2100 Tel: (031) 463-9944
Fax: 55-031-4615501 [9/94]

NEW JERSEY–River Edge
Everything for R/C, U/C and F-F modeling R/C cars, boats, planes, helis and tanks; rocketry. Engines, radios, supplies, books and videos. Modeling tools equipment and accessories—and much more at discount prices. Huge inventory.
Visa/MasterCard/Discover.

AMERICA'S HOBBY CENTER
820 Kinderkamack Rd. (201) 265-2044
[6/94]

NEW YORK–New York
Everything for R/C, U/C and FF modeling. R/C cars, boats, planes, helis and tanks; rocketry. Engines, radios, supplies, books and videos. Modeling tools equipment and accessories—and much more at discount prices. Huge inventory.
Visa/MasterCard/Discover.

AMERICA'S HOBBY CENTER
146 W. 22nd St.
(between Sixth & Seventh Ave.) (212) 675-8922
[6/94]

FLORIDA-Winter Springs
UPS orders shipped daily. Dealer for Yellow Aircraft. Send $3 for Yellow info pack. Full line of hobby accessories. Visit our showroom—35 mins. from Disneyworld.

BOB FIORENZE HOBBY CENTER, INC.
420 W. S.R. 434 (407) 327-6353
[6/94]

OHIO-Findlay
Findlay's local R/C dealer—planes, cars, boats. We specialize in R/C. Large selection of kits, accessories and parts. We're authorized Sig and Dremel dealers. We also sell model rocket and model railroad supplies. NEHO gauge. Tue./Thu. 1-9; Mon./Wed./Fri. 10-9; Sat. 10-5.

JINX MODEL SUPPLIES
721 Rockwell Ave. (419) 422-5589
[9/94]

Send sales message and payment to:

Model Airplane News,
Hobby Shop Directory,
251 Danbury Rd.,
Wilton, CT 06897.

For more information, call toll-free (800) 243-6685 and ask for Arlene Melko.

AIRWAVES

(Continued from page 120)

there a company that produces the great-looking markings like those I see at Top Gun? Do modelers such as Frank Tiano and Diego Lopez use decals, or are all the markings painted on? Perhaps Mr. Tiano could give more space to Top Gun model finishes and markings in his "Sporty Scale" column. I want to do the best job I can on my Mustang. Can you help me get started on the right foot?

EDWARD E. PARIS
Westminster, MD

Ed, thanks for your comments. Scale is one of the most popular segments of our sport, and people such as Frank Tiano are to be commended for their efforts and support in promoting scale. The models at Top Gun are among the finest in the world; the modelers who engineer and build them are very dedicated, to say the least.

Most scale builders think about the finish all the way through the construction of their model. That is to say, everything they do—from stringer and former alignment to planking and sanding the model—is done precisely and carefully. The fewer "dings" that get into the model's surface, the less filling and re-sanding will be required.

The most popular, commercially available markings for jets and warbirds are offered by companies such as Aeroloft Designs and Dry-Set Model Markings. These precision, scale, dry-transfer (rub-on) decals are handmade and are the thinnest and of the best quality.

We'll pass along your suggestion to Frankie T, and maybe he'll devote a column to painting and marking the "Top Gun way." To contact Dry-Set Model Markings, write to 7029 Sanger Ave., Waco, TX 76710; (817) 741-0379. For a catalogue and a small sample of Aeroloft Designs markings, write to 2940 W. Gregg Dr., Chandler, AZ 85224; (602) 838-0447. Tell them that Model Airplane News sent you. GY

CLASSIFIEDS

RATES: non-commercial—25 cents per word. No charge for name and address (no commercial ads of any kind accepted at this rate); commercial— 50 cents per word (applies to retailers, manufacturers, etc.); count all initials, numbers, name and address, city, state, zip code and phone number. **All ads must be paid for in advance.**
To run your ad for more than one month, multiply your payment by the number of months you want it to run. Deadline: the 10th day of the month, 3 months in advance, e.g., *January 10 for the April issue.* We don't furnish box numbers, and it isn't our policy to send tear sheets. **SEND AD AND PAYMENT TO: CLASSIFIED ADS, Model Airplane News, 251 Danbury Rd., Wilton, CT 06897.**

R/C WORLD ORLANDO, FL, CONDO RENTAL: 2 bedroom, furnished. Available weekly or monthly. Low rates. 100-acre flying field with enclosed hangars. Close to Disney World and Epcot Center. For information, please call or write to R/C World, 1302 Stearman Ct., Orlando, FL 32825; (407) 380-6359.

WANTED: *model engines and race cars before 1950. Don Blackburn,* P.O. Box 15143, Amarillo, TX 79105; (806) 622-1657. [6/94]

WANTED: your old proportional radios; interested in pre-1980, American made; C&S, Deans, Klinetronics Spar and others. Older is better. Ron Gwara, 21 Circle Dr., Waverly, NY 14892; (607) 565-7486. [9/94]

WANTED: model-airplane engines and model race cars made before 1950. Jim Clem, 1201 E. 10, P.O. Box 524, Sand Springs, OK 74063; (918) 245-3649. [6/94]

WANTED: old engine parts, misc. junk before 1970. Wesley Pettinger, 1501 Banbury Ct., Richardson, TX 75082; (214) 669-4003. [7/94]

ANTIQUE IGNITION AND GLOW PARTS CATALOGUE: 100 pages–timers, needle valves, original cylinder heads, point sets, drive washers, stacks, spark plugs, plans. Engines: Atwoods, Baby Cyclones, McCoys, Hornets, others. $8 post-paid, U.S.; $20, foreign. Chris Rossbach, R.D. 1 Queensboro Manor, Box 390, Gloversville, NY 12078. [8/94]

NEW ZEALAND AERO PRODUCTS—Scale plans: Agwagon, Pawnee, Pawnee Brave, Airtruk/Skyfarmer, Fletcher FU-24, Aerobat, Hall's Springfield Bulldog, Typhoon, DC-3/C-47, Fairchild PT-19/Fleet PT-26 and more. Fiberglass parts; hardware packs; timber packs; color photo packs available. Free documentation with plans. Catalogue/price list: $5 (U.S.); Visa/MC. 34 Ward Parade, Stirling Point, Bluff, New Zealand; (03) 212-8192. [2/95]

HELICOPTER SCHOOL—five days of hands-on instruction with X-Cell helicopters and Futuba computer radios. Small classes tailored to your individual needs. Beginner to expert. Includes all meals and lodging. Over 300 satisfied students and 10,000 flights logged. Located on a 67-acre airport used exclusively for R/C training; owned and operated by Ernie Huber, five-time National Helicopter Champion and helicopter designer. Send for *free* information and class schedule *now!* R/C Flight Training Center, P.O. Box 727, Crescent City, FL 32112-0727, or call (800) 452-1677. Outside USA: (904) 698-4275, or fax (904) 698-4724. [6/94]

ANTIQUE AIRPLANE PRINTS, 8x10 color prints. Stearman, Gee Bee, Waco, Jenny, P.T. Ryan; 10 in all. Send $1 (refundable) for color brochure. Robert Kohr, P.O. Box 204, York, PA 17405. [5/94]

SALE—kits: wood, plastic; ignition engines; parts and mags (pre-1965). Specify needs. Send SASE and 60 cents for list. Leonard Roberts, 3819 Lydon Ln., Moosic, PA 18507; (717) 961-2357. [12/94]

CUSTOM KIT BUILDING. Will build most kits from trainers to ¼ scale; 20 years experience. Write for quotes: Midwest Model Factory, 280060 Highland Rd., Minatare, NE 69356. [8/94]

WANTED: built or partially built Ercoupes, Cessna 150, 152, 172, 182, Grumman American Tiger (AA5), American Yankee (AA1), or Mooney M-10 Cadet. Glen Mills, P.O. Box 3393, Mission Viejo, CA 92690; (714) 768-0585. [11/94]

PLANS ENLARGED. Scanning/plotting services; model designer's computer software; free information. Concept, P.O. Box 669E, Poway, CA 92074-0669; (619) 486-2464.

MAKE REAL DECALS with your computer and printer! Send $10 for starter kit and instructions to LABCO, 27563 Dover, Warren, MI 48093-4764. [11/94]

GIANT-SCALE PLANS by Hostetler. Send SASE to Wendell Hostetler's Plans, 1041 B Heatherwood, Orrville, OH 44667. [11/94]

ENGINES: IGNITION, GLOW, DIESEL—new, used, collectors, runners. Sell, trade, buy. Send $3 for huge list to Rob Eierman, 504 Las Posas, Ridgecrest, CA 93555; (619) 375-5537. [11/94]

ARE YOU TIRED OF PAYING $1.29 for six screws? For a *free* catalogue and price list of screws, nuts, locknuts, blind nuts and more, in sizes from 0-80 to ¼ inch, contact Micro Fasteners, 110 Hillcrest Rd., Flemington, NJ 08822; (800) 892-6917; fax (908) 788-2607. [11/94]

MODEL MOTORS WANTED—Most types, 1970 and earlier. Cash or trade. T. Crouss, 100 Smyrna, West Springfield, MA 01089. [9/94]

R/C SKYDIVING—illustrated catalogue: $1. R/C Skydivers, Box 662N, St. Croix Falls, WI 54024. [7/94]

MODEL HOT-AIR BALLOONS. Fly thousands of feet high; visible for miles at night; build for pennies each. Photo-illustrated instructions. Send $5 to Air-Crafts, Dept. B, 62 S. Gate Dr., Poughkeepsie, NY 12601. [5/94]

BALL BEARINGS—now! Full-time bearing service. Bearings in stock to fit most model engines, steel, phenolic, or polymide. Installation available. UPS service; SASE for price list: Revmor, P.O. Box 548, Palm City, FL 34990; (407) 283-6831. [7/94]

ANTIQUE IGNITION engine parts: excellent reproductions, fuel tanks, points, timers, coils, needle valves, gaskets, etc. Champion spark plugs. Catalogue—$5 (intl. airmail—$7). Aero-Electric, 1301 W. Lafayette St., Sturgis, MI 49091. [8/94]

WANTED: ignition model engines 1930s to 1950s, especially Elf, Baby Cyclone, Brown Jr., Ohlsson Custom and Gold Seal. Also model racecars, any parts, spark plugs, etc.; Woody Bartelt, 1301 W. Lafayette St., Sturgis, MI 49091; (616) 665-9693, or (800) 982-5464. [8/94]

LOCKHEED P-38 LIGHTNING. If P-38s—R/C scale models or full size—are your *thing*, join the P-38 Model Organization International—a worldwide association for P-38 enthusiasts. For more information, send $1 to P-38 M.O.I. Medelbyvej 54 DK 2610 Rodovre, Copenhagen, Denmark.

SCALE DOCUMENTATION and resource guide. Larger, updated 1994 Edition. World's largest commercial aircraft collection. Over 5,000 different color FOTO-PAAKS and 25,000 three-view drawings; 152-page resource guide/catalogue—$6 (Canada—$7; foreign—$12). Bob Banka's Scale Model Research, 3114 Yukon Ave., Costa Mesa, CA 92626; (714) 979-8058. [8/94]

INTERNATIONAL AIRCRAFT RESEARCH: need documentation? Include name of aircraft for availability of documentation, with $3 for photo and three-view catalogue. 1447 Helm Ct., Mississauga, Ontario, Canada L5J 3G3. [9/94]

MAKE EXTRA CASH FOR YOUR HOBBIES. Do it at home. It's easy! Send $2 with SASE to Cash Concepts, 1973 Nellis Blvd. Dept 356, Las Vegas, NV 89115. [6/94]

WANTED! November 1940 issue of *Model Airplane News* complete, contact: S.A. Lindberg, 115 Del Oro Circle, Colorado Springs, CO 80919. [6/94]

SCRATCH-BUILDERS WANTED to work part-time at home assisting with completion and flight testing of composite kits. Need experience in one of the following: Q-500, giant-scale sport 100-inch+ span, sailplane 144-inch+ span. Write to Scratch-Builder, P.O. Box 6165, Philadelphia, PA 19115. [5/94]

MAGAZINE BACK ISSUES—*Flying Aces, Model Airplane News, Air Trails*, 1930s and '40s. FM, RCM and more. Send SASE for list to Carolyn Gierke, 1276 Ransom Rd., Lancaster, NY 14086. [9/94]

NEW FIBERGLASS UH-60A helicopter fuselage for .60-size mechanics: $250. (203) 288-5719. [7/94]

MAGAZINES—50 *Old Timers* (22 pounds): $50; 244 *Model Builders:* 1971-1991 (3x40 pounds): $125. Send SASE for list. George Wilson, 82 Frazier Way, Marstons Mills, MA 02648. [5/94]

PAYING $50 each for toy metal outboard boat motors—Mercury, Evinrude, Gale, Oliver, Scott, Johnson. Ship for immediate payment, or call (616) 941-2111; Richard Gronowski, 140 N. Garfield Ave., Traverse City, MI 49684. [8/94]

MODEL GRAPHICS/VINYL LETTERING—Introducing new 20-page instructional catalogue and model decorating guide. *Special offer:* any combination of 10, 2-inch letters or numbers, custom-cut and ready to install, with catalogue—$4.95. Graphics A.M.P. Inc., 42a Nancy St., W. Babylon, NY 11704; (516) 253-2702. [7/94]

FOR SALE—*Model Builder* magazine collection, published by Bill Northrop, Jr.—issues no. 1 through no. 173, except issue no. 122; first 10 years in binders—all excellent condition. Sell to best offer received by June 30, 1994. Duplicate issues of above; 1976 and 1977 complete; 47 additional issues. SASE for list. Engine collectors journal, Vols. 1 through 14 sold as lot (b.o. as above). Meca Bulletins, no. 1 through 80, sold as lot (b.o. as above). Shipping additional. Howard Carman, 7 Claire Dr., Hilton Head Island, SC 29928-3937. [5/94]

SMOOSHIE BAILS OUT! Release a scale-like parachutist!—a real crowd pleaser and a lot of fun! For a brochure, send SASE to Hobby Hut Mfg., 2040 W. 21st. N., Ste. 77, Wichita, KS 67203-2107 (Dept MAN). [10/94]

GERMAN AIRCRAFT WW II—handbooks, service part lists, instruction manuals. List—$2. Udo E Hafner, Eugen-Bolz-Str. 15, D-71636 Ludwigsburg, Germany. [11/94]

KIT CUTTING—Will custom-cut any kit to your specifications. Your plans or mine—*guaranteed* quality like none other. Call or write: 43940 Yorktown, Canton, MI 48188; (313) 697-6804. [8/94]

HELP! I need the following toy metal outboard boat motors: *Oliver*, Gale Sovereign, Buccaneer, *Evinrude* Lark, Starflite, *Mercury* Mark 55,75,78,1000, *Scott-Atwater, Johnson* 40, 75, *Sea-Fury* 2-cylinder. Paying $75 to $100 each. Richard Gronowski, 140 N. Garfield Ave., Traverse City, MI 49684; (616) 941-2111. [8/94]

FOR SALE: Concept 30DX helicopter, Hughes 500 fiberglass fuselage, Ninja blades, Futaba heli radio, gyro, complete flight box—excellent condition; many extras. Call (315) 331-8163. [6/94]

R/C PRODUCTS: CA Tip Extender—6 for $1 (2- and 4-inch). Discounted kits, balsa, ply, hardware, etc. Catalogue—$2. Shoreham Model Airplanes, P.O. Box 794, Shoreham, NY 11786. [8/94]

P-38 LIGHTNING—Columbia Model Works kit: 95-inch wingspan, SuperTigre 2500s, Robart retracts, Futaba radio. Everything new—never been flown. Will crate and ship—$2,800 (Lasalle, IL). (815) 223-6782. **Note: previously advertised with incorrect telephone number—call again.** [7/94]

WW I PLANS—Peanut to 100 inches. Send $2 for illustrated catalogue to Clark Smiley, 23 Riverbend Rd., Newmarket, NH 03857. [3/95]

CASH FOR ENGINES: ignition, glow, diesel—all types; any condition; sale list, too! Estates my specialty! Send SASE for list: Bob Boumstein, 2811 S. 165th Ave., Omaha, NE 68130; (402) 334-0122. [8/94]

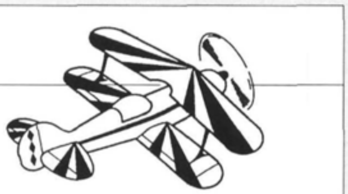
ONE-INCH BELT SANDER. Build yours for less than $20. No special tools required. Send $7 to Crafty Creations, Box 222, Burlington, KS 66839. [8/94]

DORNIER D026 PLANS—118-inch wingspan; other seaplanes. For information, send SASE with two postage stamps to Gene Falada, Sea-Clusion Aeronautics, 22W070 Byron, Addison, IL 60101. [7/94]

MAGAZINE BACK ISSUES—*Air Trails, Model Airplane News,* 1940s, 1950s. Send SASE for list to Gary Nachbar, 13822 White St., Springville, NY 14141. [7/94]

FOR SALE: Airtronics Spectra with contest servos, extra batteries, transportation case, retract servo, microservo—all options: $300 (or best offer). Airtronics Spectra standard system: $175 (o.b.o.). Airtronics Vision—brand-new and contest ready: $350 (o.b.o.). Call Ryan: (904) 483-1822. [6/94]

CLUB OF THE MONTH



CHANNEL ISLANDS CONDORS

P.O. Box 1993, Camarillo, CA 93011

The Channel Islands Condors' March *Condor III* newsletter is a well-put-together, 27-page booklet that's packed with useful modeling tips, event schedules and interesting information. This club is so active that there's already a calendar of events mapped out for the entire year!

One of the notable events is a fly-in sponsored by Carl Goldberg Models that will be held on November 13 and 14 at Condor Field. Club member and contest director Charlie Shafer met with *Model Airplane News* columnist Dave Patrick to discuss the specifics of the event. CGM will donate more than $2,000 in prizes and will help coordinate the event.

Not only is this club busy scheduling events, but it also keeps its members involved by holding pancake breakfasts, raffles, contests and meetings.

The newsletter also contains a short article on helicopter flying written by the esteemed John Gorham, a regular contributor to *Model Airplane News*. John lists some general rules on heli flying at fixed-wing fields and also suggests rules for flying at the club's heli site.

In a humorous short story, "The Wrong Brothers Fly Again...," John Strobel gives a fictitious account of a day of flying with Orville and Wilbur—Wrong, that is.

One of the newsletter's highlights is a list of "common courtesy" rules. Club vice president Bob Gray encourages members to adhere to them. Our favorite is: "If you spill a half gallon of fuel while fueling up, grab a paper towel or a rag, and wipe it up. Whether it's on the table or on the pavement, the next flier is not going to appreciate that sticky puddle!" Bob, we couldn't agree with you more.

Congratulations to the Channel Islands Condors for being our "Club of the Month." We hope that you will enjoy your two complimentary subscriptions to *Model Airplane News!* ■

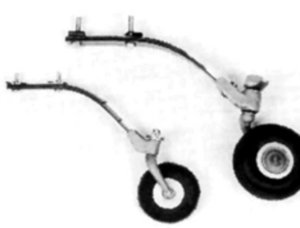
PRODUCT NEWS

CARL GOLDBERG MODELS
Sukhoi

This Sukhoi's ultralight loadings let you draw the kind of extended vertical lines, crisp corners and compact, perfectly formed figures that are essential for thrilling, pro-style aerobatic sequences. This plane does torque rolls, inside and outside snaps that start and stop instantly, plus tumbling maneuvers. The kit includes a complete, top-quality hardware package; a formed cowl; a canopy; and a belly pan. Specifications: wingspan—72½ inches; wing area—949 square inches; flying weight—8¾ to 9½ pounds; length—65 inches; power—.90 2-stroke, 1.20 4-stroke.

Kit no.—67; **price**—$249.99.

Carl Goldberg Models, 4734 W. Chicago Ave., Chicago, IL 60651; (312) 626-9550.



SCALE AVIATION
Tail-Wheel Assemblies

New from Scale Aviation USA are ⅓-scale (TA 2000) and ¼-scale (TA 1000) tail-wheel assemblies. The TA 2000 is a ready-to-mount unit and comes with a right- or left-hand fork; a lightweight, 2-inch-diameter 200T Du-Bro treaded wheel; a stainless-steel investment-casted fork; three ½x$\frac{1}{16}$-inch spring-steel main leaf springs; and all attachment fittings, including chains and springs. The TA 1000 has a 1½-inch wheel.

Prices—$54.95 (TA 2000 series), $46.95 (TA 1000 series) plus $4 S&H. Separate fork sets are available for both units.

Scale Aviation USA; distributed by Cirrus Ventures, 115 Hunter Ave., Fanwood, NJ 07023-1030; (908) 322-7221.

TAUCOM
R/C Power Duck

No longer will you have to deal with bent antennas, antenna crowding, or dangerous winch lines. The R/C Power Duck rubber ducky antenna can be quickly disconnected from your transmitter through a BNC mount. Each antenna is individually hand-tuned to 72MHz to ensure the closest SWR (standing wave ratio) match and highest RF output. Each is approximately 12 inches long and comes in black, blue, red, pink, or yellow.

Price—$23.95 (plus $3 S&H; CA residents, add 7.75-percent sales tax).

TauCom, 2490 S. Ola Vista, #28, San Clemente, CA 92672; (714) 492-9553; fax: (714) 586-8508.

HITEC RCD
RCD3000 Supreme Series Receiver

This 0.8x1.4x2.3-inch, 1.34-ounce, FM, dual-conversion receiver far exceeds the AMA's narrow-band standards. It has tighter adjacent-channel rejection, higher 30IP rejection and more sensitivity (thus, longer range). It works with only Hitec/RCD dual-conversion crystals.

Part nos.—RCD3200 (Futaba J), RCD3400 (Airtronics), RCD3500 (Hitec), RCD3600 (JR); **price**—$99.95 each.

Hitec RCD Inc., 10729 Wheatlands Ave., Ste. C, Santee, CA 92071; (619) 258-4940; fax: (619) 449-1002.

GREAT PLANES
Armament Package

Each package includes 12 MK-82 bombs, four Sparrow missiles, two bomb pylons and two missile pylons. The missile and bomb bodies come primed and ready to paint. Assembly and mounting are fast and easy. Although the armament package was designed specifically for Great Planes' jet-like sport kits, it can also be used with many other R/C planes.

Part no.—GPMQ5010; **price**—$29.99.

Great Planes Model Distributors Co., P.O. Box 9021, Champaign, IL 61826-9021; (217) 398-6300.

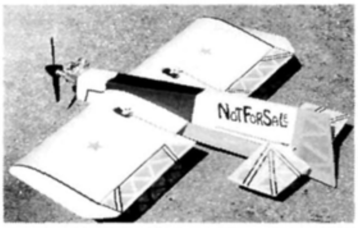
AEROLOFT DESIGNS
Trim Aircraft F-20 and Spectre

The Trim Aircraft F-20 is an intermediate-class ducted-fan jet with a full flying stab, flaps and retractable landing gear. The Spectre is an intermediate-class sport jet with a full flying stab. Drop the flaps, and this jet slows down for a nice, smooth landing. Designed around the Ramtec fan unit, each kit includes an epoxy/glass fuselage, intakes, a thrust tube, foam wings and stabs, a fuel tank, a clear canopy and hardware.

Prices—$525 (F-20), $500 (Spectre), plus $25 S&H.

Aeroloft Designs, 2940 W. Gregg Dr., Chandler, AZ 85224; (602) 838-0447.

PRODUCT NEWS



NOTFORSALE ENTERPRISES
NOTFORSALE

This sport/fun-fly kit is available in .40 and .20 size. It features plywood die-cut parts and hand-selected balsa and spruce, and the ribs are precut and sanded. The kit includes formed landing gear and a large accessory pack. Specifications (.40-size): wingspan—53 inches; wing area—744 square inches; weight—3½ to 5 pounds; engine—.32 to .46; radio—4-channel (with five servos). Specifications (.20-size): wingspan—42 inches; wing area—456 square inches; weight—2 to 3½ pounds; engine—.12 to .32; radio—4-channel (with five servos).

Kit nos.—024, 022; **prices**—$99.95, $79.95 (plus $5 S&H); limited special prices—$69.95, $59.95.

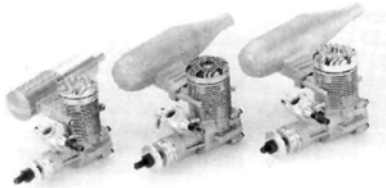
NFS Enterprises, P.O. Box 2254; Crystal River, FL 34423; (904) 563-0894; (800) 780-1819 (for orders only).

JOMAR PRODUCTS
Mini-Max

The 1-ounce, 1x1.5x.5-inch Mini-Max is one of the smallest, lightest electric speed controllers ever built. Despite its tiny size, the unit is capable of controlling .01- to .15-size motors using one to 16 cells. The Mini-Max features high rate; soft start; a brake; a throttle-guard; auto setup; and extensive signal-processing, glitch-filtering software. Included with the controller are the latest solvent-resistant Sermos connectors for the motor and battery and a JR-type lead for the receiver connection.

Price—$79.95 (plus $2 S&H).

Jomar Products, 3440 Riverhills Dr., Cincinnati, OH 45244; (513) 271-3903.



WEBRA
Speed GT Engines

Webra announces a new engine series—the Speed GTs. Each GT engine includes a muffler, a machined-aluminum throttle arm for reliability and an updated TN II carburetor, which has an O-ring seal on the high-speed needle for more consistent needle settings. Available in .32, .40 and .50ci displacements, GTs are backed by a full two-year warranty.

Part nos.—WEBE 329 (.32), WEBE 416 (.40), WEBE 501 (.50); **prices**—$169.95, $189.95, $229.95.

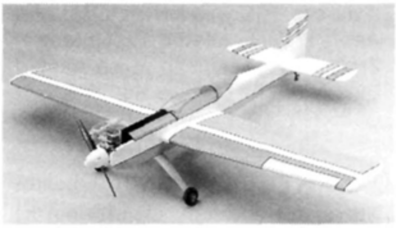
Webra; distributed by Horizon Hobby Distributors, 4105 Fieldstone Rd., Champaign, IL 61821; (217) 355-9511.

SIG MFG.
Fazer

This easy-to-build, all-wooden, state-of-the-art, fun-fly airplane is capable of tight loops and super-fast rolls. The kit includes a pre-shaped balsa profile fuselage; die-cut balsa ribs and ply doublers; pre-bent aluminum landing gear; a glass-filled engine mount; a complete hardware package; and Sig Easy Hinges. Specifications: engine—.25 to .40 2-stroke, .40 to .50 4-stroke; wingspan—48 inches; wing area—697 square inches; length—40 inches; wing loading—11.6 to 13.2 ounces per square foot; weight—3½ to 4 pounds; radio—4-channel (with five servos).

Part no.—RC68; **price**—$69.95.

Sig Mfg. Co. Inc., 401 S. Front St., Montezuma, IA 50171; (515) 623-5154.



MODEL TECH
Hurricane BHP™

This sport/pattern airplane kit includes prebuilt and pre-sanded component parts: a clear canopy; balsa-sheeted, foam-core wings; basic hardware, including metal main gear, sprung tail-wheel gear, axles, threaded horns and aluminum wing-blade joiners. Specifications: wingspan—53.2 inches; wing area—545 square inches; weight—4½ to 5 pounds; engine—.40 2-stroke, .60 4-stroke; radio—4-channel.

Part no.—123780; **price**—$170.

Model Tech; distributed by Global Hobby Distributors, 10725 Ellis Ave., Fountain Valley, CA 92728-8610; (714) 963-0133.

REPLICA ENGINES
Spark Plug

Replica Engines, the maker of precision-scale, multi-cylinder engines, introduces its ¼-32 spark plug—reminiscent of the Old Champion V3. Replica designed the plug for its own engines and promises immediate delivery.

Price—$12.50

Replica Engines, Top o' the Lake Rd. and S. Lake Michigan Rd., Rte. 1, Box 61B, Gulliver, MI 49840; (906) 283-3321; fax: (906) 283-3325.

Descriptions of products appearing in these pages were derived from press releases by the manufacturers and/or their advertising agencies. The information given here does not constitute endorsement by **Model Airplane News**, nor guarantee product performance. When writing to the manufacturer about any product described here, be sure to mention that you read about it in **Model Airplane News**. **Manufacturers!** To have your products featured here, address the press releases to **Model Airplane News,** attention: Julie Soriano.

NAME THAT PLANE

CAN YOU IDENTIFY THIS AIRCRAFT?

If you can, send your answer to *Model Airplane News*, **Name That Plane Contest** (state issue in which plane appeared), 251 Danbury Rd., Wilton, CT 06897.

CONGRATULATIONS to Charles P. Stover for correctly identifying the March '94 mystery plane. The Sepecat Jaguar T. Mk2 was built as a cooperative British/French effort by British Aerospace and Dassautl-Breguet. The aircraft shown—a two-seater (pilot and student sit side by side)—is the British version that first flew in 1971. Conceived as an operational conversion trainer with secondary strike and ground-attack capabilities, the plane was equipped with one 30mm Aden cannon and five external hardpoints capable of carrying a total load of 10,000 pounds, including bombs, rocket pods, air-to-surface missiles and a tactical nuclear weapon. With a wingspan of 28½ feet and two Rolls-Royce engines turning Turbomeca turbo fans, its maximum speed was Mach 1.6 at altitude, and the service ceiling was 45,930 feet. ■

The winner will be drawn four weeks following publication from correct answers received (on a postcard delivered by U.S. Mail), and will receive a free one-year subscription to **Model Airplane News**. If already a subscriber, the winner will receive a free one-year extension of his subscription.

INDEX OF MANUFACTURERS

Ace R/C Inc., *116 W. 19th St., Box 511C, Higginsville, MO 64037.*

Aero Publishers, *Tab Books, Blue Ridge, Summit, PA 17294-0214.*

Airdrome Plans Service, *P.O. Box 1425, FDR Stn., New York, NY 10150; (212) 421-1440.*

Airtrax, *manufactured by L&R Aircraft Ltd., 13645 Fisher Rd., Burton, OH 44021.*

Airtronics Inc., *11 Autry, Irvine, CA 92718.*

American Model Products, *Rte. 3, P.O. Box 57, Baxley, GA 31513; (912) 367-0567.*

APC Props; *distributed by Landing Products, P.O. Box 938, Knights Landing, CA 95645.*

AristoCraft/Polk's Model Craft Hobbies, *346 Bergen Ave., Jersey City, NJ 07304.*

AstroFlight Inc., *13311 Beach Ave., Marina Del Rey, CA 90292.*

B&B Specialties, *14234 Cleveland Rd., Granger, IN 46530.*

Bennett, *distributed by B&B Specialties, (see address above).*

Carl Goldberg Models, *4734 W. Chicago Ave., Chicago, IL 60651.*

Condor R/C Specialties, *1733-G Monrovia Ave., Costa Mesa, CA 92627; (714) 642-8020.*

Dave Brown Products, *4560 Layhigh Rd., Hamilton, OH 45013.*

Du-Bro Products, *480 Bonner Rd., Wauconda, IL 60084.*

Enya; *distributed by Altech Marketing, P.O. Box 391, Edison, NJ 08818-0391.*

EZ; *distributed by Hobby Shack, 18480 Bandilier Cir., Fountain Valley, CA 92728.*

Flightec, *21 Juniper Way, Hamilton, NJ 08619; (609) 584-9409.*

Futaba Corp. of America, *4 Studebaker, Irvine, CA 92718.*

Global Hobby Distributors, *10725 Ellis Ave., Fountain Valley, CA 92728; (714) 964-0827.*

Great Planes Model Distributors, *P.O. Box 9021, Champaign, IL 61826-9021; (217) 398-6300.*

Gulf Stream Air Video Inc., *P.O. Box 482, Hagan GA 30429; (800) 531-1784.*

Hirobo; *distributed by Altech Marketing, P.O. Box 391, Edison, NJ 08818-0391; (908) 248-8738.*

Icare Sailplanes, *381, Joseph-Huet, Boucherville, Quebec, Canada J4B 2C5; (514) 449-9094.*

Imperial Coachworks, *405 Plum Industrial Ct., Pittsburgh, PA 15239.*

Infinity; *distributed by Gulf Stream Air Video Inc. (see address above).*

Irwin Pipes, *7809 S. Sun Mor Dr., Muncie, IN 47302; (313) 747-4190.*

Jet Hangar Hobbies, *12130 G. Carson St., Hawaiian Gardens, CA 90716.*

JR Remote Control; *distributed by Horizon Hobby Distributors, 4105 Fieldstone Rd., Champaign, IL 61821.*

K&B Mfg. Inc., *2100 College Dr., Lake Havasu City, AZ 86403.*

K&S Engineering, *6917 W. 59th St., Chicago, IL 60638; (312) 586-8503.*

Kalt; *distributed by Horizon Hobby Distributors (see address above).*

Klett; *distributed by Carl Goldberg Models (see address above).*

Kyosho/Great Planes Model Distributors *(see address above).*

Master Airscrew; *distributed by Windsor Propeller Co., 3219 Monier Cir., Rancho Cordova, CA 95742.*

McCoy Racing, *1778 Albright Ave., Upland, CA 91786.*

Miniature Aircraft USA, *3743 Silver Star Rd., Orlando, FL 32808; (404) 292-4267.*

Model Engineering of Norwalk, *54 Chestnut Hill Rd., Norwalk, CT 06851.*

MonoKote; *distributed by Great Planes Model Distributors (see address above).*

Morgan Inc., *P.O. Box 1201, Enterprise, AL 36331.*

NASSA, *P.O. Box 4267, W. Richland, WA 99352.*

O.S.; *distributed by Great Planes Model Distributors (see address above).*

Raul Blacksten, *VSA Archivist, P.O. Box 307, Maywood, CA 90270.*

RCSD, *P.O. Box 2108, Wylie, TX 75098-2108; (214) 442-3910.*

Rhom Products Mfg., *8425 S.W. 129th Terrace, Miami, FL 33156; (305) 232-6615.*

Robart Mfg., *P.O. Box 1247, 625 N. 12th St., St. Charles, IL 60174; (708) 584-7616.*

Robbe Model Sport, *170 Township Line Rd., Belle Mead, NJ 08502.*

Sanyo Electric, Battery Division, *200 Riser Rd., Little Ferry, NJ 07643.*

Schlüter; *distributed by Robbe Model Sport, 170 Township Line Rd., Belle Mead, NJ 08502; (908) 359-2115.*

Sig Mfg. Co., *401 S. Front St., Montezuma, IA 50171.*

Slimline Mfg., *P.O. Box 3295, Scottsdale, AZ 85257.*

Solartex, *distributed by Global Hobby Distributors (see address above).*

Squadron/Signal Publications Inc., *1115 Crowley Dr., Carrollton, TX 75011-5010.*

SR Batteries Inc., *Box 287, Bellport, NY 11713; (516) 286-0079.*

Sullivan Products, *P.O. Box 5166, Baltimore, MD 21224.*

Tejera Microsystems Engineering Inc., *P.O. Box 340608, Tampa, FL 33694.*

Testors Corp., *620 Buckbee St., Rockford, IL 61104.*

Turbax; *distributed by Jet Hangar Hobbies (see address above).*

UFO; *distributed by Satellite City, P.O. Box 836, Simi, CA 93062.*

Varsane Products, *546 S. Pacific St., Ste. C-101, San Marcos, CA 92069.*

Vintage Sailplane Assoc. Inc., *Scott Airpark, Rte. 1, Box 239, Lovettsville, VA; 22080-9406.*

Vintage Sailplane R/C Assoc., *Richard G. Tanis, 391 Central Ave., Hawthorne, NJ 07506; (201) 427-4773.*

Windspiel Models, *P.O. Box 2121, Coeur d'Alene, ID 83816; (208) 667-2278.*

YS; *distributed by Futaba (see address above).*

Zap; *distributed by Pacer Technology, 9420 Santa Anita Ave., Rancho Cucamonga, CA 91730.*

ADVERTISER INDEX